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# **LESSON 5**

## ***Introduction to PM<sub>10</sub> Monitoring***

### ***Goal***

To familiarize you with the general considerations for monitoring PM<sub>10</sub>.

### ***Objectives***

At the end of this lesson, you will be able to:

- 1 define PM<sub>10</sub>.
- 2 describe the two classes of particulate matter that compose PM<sub>10</sub>.
- 3 identify natural and anthropogenic sources of PM<sub>10</sub>.
- 4 recognize that the EPA Reference Measurement Method for PM<sub>10</sub> requires a sampler collection efficiency of 50 percent for particles having 10 micrometer aerodynamic diameters.
- 5 describe the transport, transformation, and removal mechanisms for PM<sub>10</sub>.
- 6 recognize the seven principal uses for PM<sub>10</sub> ambient air data.
- 7 explain the need for considering sources of particulate emissions, patterns of terrain and physiography, and climatology when selecting a PM<sub>10</sub> monitoring site.
- 8 describe three methods for estimating spatial and temporal distributions of PM<sub>10</sub> emissions in a potential PM<sub>10</sub> air monitoring area.
- 9 approximate the downwind distance that an air flow will be affected by an obstacle.
- 10 describe air circulation patterns for lake(sea)/land breezes.
- 11 identify two methods for determining the size and extent of areas affected by lake(sea)/land breezes.
- 12 recognize the effects of buildings on air flows.

- 13 describe air circulation patterns caused by urban heat islands.
- 14 identify three climatological parameters that affect the distribution of PM<sub>10</sub> in ambient air, and describe how they can be measured.
- 15 describe meteorological conditions that are frequently associated with poor air quality.
- 16 recognize the two averaging times of interest for PM<sub>10</sub> air quality levels.

### ***Procedure***

- 1 Read pages 1-43 of EPA-450/4-87-009 *Network Design and Optimum Site Exposure Criteria for Particulate Matter*.
- 2 Complete the review exercise for this lesson.
- 3 Check your answers against the answer key following the exercise.
- 4 Review the pages in the reading for any questions you missed.
- 5 Continue to Lesson 6.

***Estimated student completion time: 4 hours***

### ***Reading Assignment Topics***

- Physical and chemical characteristics of PM<sub>10</sub>
- Sources of PM<sub>10</sub>
- Measurement of PM<sub>10</sub>
- Distribution patterns of PM<sub>10</sub>
- Transport, transformation, and removal of PM<sub>10</sub>
- Monitoring objectives for PM<sub>10</sub>
- Spatial scales of representativeness
- Emission sources, terrain, and climatology effects on PM<sub>10</sub> ambient air concentrations

## ***Reading Guidance***

IP (inhalable particulate matter) means particulate matter having an aerodynamic diameter less than or equal to a nominal 15 micrometers.

Figure 2 of the reading assignment is incorrectly titled. The correct title is "Idealized fine and coarse particle mass and chemical composition."

Synoptic scale winds cover a vertical distance of up to 5 kilometers and a horizontal distance of up to 1,000 kilometers.

Refer often to the figures while reading the material describing topographical influences on air flow.

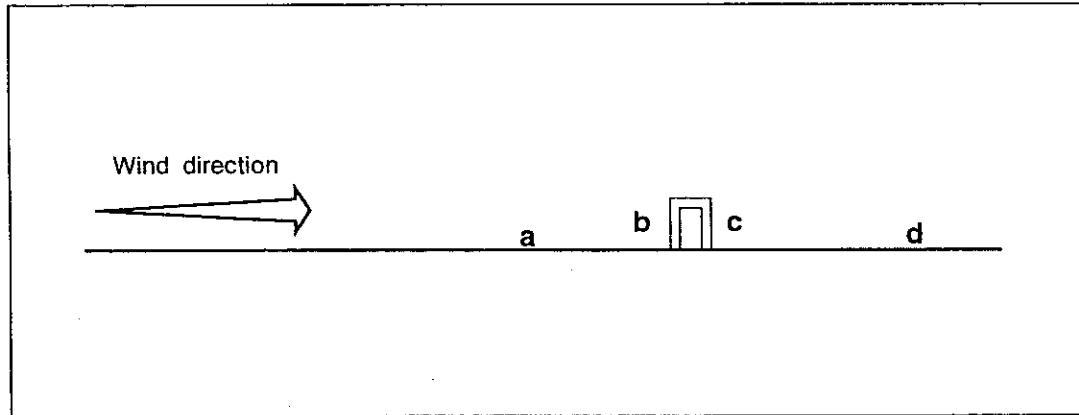
# Review Exercise

Now that you've completed the assignment for Lesson 5, please answer the following questions to determine whether or not you are mastering the material.

1. For particulate matter to be classified as PM<sub>10</sub>, it must \_\_\_\_\_.
  - a. have an aerodynamic diameter of exactly 10 micrometers
  - b. have an aerodynamic diameter less than or equal to a nominal 10 micrometers
  - c. be measured by the reference method described in Appendix J of 40 CFR 50 or by an equivalent method designated in accordance with 40 CFR 53
  - d. both a and c, above
  - e. both b and c, above
2. The fine particulate matter mode of PM<sub>10</sub> is composed of particles having aerodynamic diameters less than or equal to a nominal \_\_\_\_\_ micrometers.
  - a. 0.1
  - b. 1.0
  - c. 2.5
  - d. 3.5
  - e. 5.0
3. True or False? The coarse particulate matter mode of PM<sub>10</sub> is composed of particles having aerodynamic diameters between a nominal 5 and 10 micrometers.
4. True or False? Fine particles mainly result from combustion processes.
5. Fine particles typically consist of \_\_\_\_\_.
  - a. sulfates
  - b. nitrates
  - c. carbonaceous organics
  - d. ammonium
  - e. all of the above
6. True or False? Coarse particles typically consist of crustal material, sea salt, and plant particles.
7. \_\_\_\_\_ produce coarse particles.
  - a. mechanical processes
  - b. wind erosion
  - c. a and b, above
  - d. none of the above

8. The PM<sub>10</sub> reference method has a collection efficiency of \_\_\_\_\_ percent for particles having aerodynamic diameters of 10 micrometers.
  - a. 100
  - b. 95
  - c. 75
  - d. 50
9. Which of the following is a (are) true statement(s) concerning the transport, transformation, and removal of PM<sub>10</sub>?
  - a. PM<sub>10</sub> emitted into the atmosphere is transported by the wind and diluted by various atmospheric turbulence and mixing processes.
  - b. Airborne PM<sub>10</sub> may grow by condensation, coagulation, and chemical reactions.
  - c. PM<sub>10</sub> growth processes are inhibited by moisture.
  - d. PM<sub>10</sub> is removed from the atmosphere by wet and dry processes.
  - e. a, b, and c, above
  - f. a, b, and d, above
10. Principal uses for PM<sub>10</sub> data include \_\_\_\_\_.
  - a. evaluation of ambient air quality
  - b. protection of public health
  - c. development and testing of receptor models
  - d. a and b, above
  - e. all of the above
11. True or False? Land use information can be used to prepare PM<sub>10</sub> emissions maps.
12. True or False? The homogeneity of PM<sub>10</sub> ambient air concentrations is not affected by terrain.
13. The distance that an obstacle will affect downstream air flow is approximately equal to \_\_\_\_\_ times the height of the obstacle.
  - a. 2
  - b. 5
  - c. 10
  - d. 100

14. Which of the following conditions is (are) needed to cause a land/sea breeze circulation?
- strong synoptic winds
  - strong thermal contrast between water temperatures and land temperatures
  - light synoptic winds
  - a and b, above
  - b and c, above
- 15 True or False? Land breezes occur at night during a land/lake breeze circulation.
- 16 True or False? Air temperature and relative humidity patterns can be used to estimate the size and extent of areas affected by land/lake breezes.
17. Which of the locations, labeled a through d, would be the most likely site of an air cavity zone?



18. True or False? When a heat island circulation exists, there is a convergence zone over the center of the city and a return flow into outlying areas.
19. True or False? Heat island circulations can be overwhelmed by strong regional winds.
20. True or False? Large urban areas that have populations in the millions can exhibit a heat island circulation even if regional winds are quite strong.

Match each of the following climatological parameters with its measurement technique(s).  
(Questions 21-23)

- |                   |   |
|-------------------|---|
| 21. advection     | a. measuring wind speed and direction at 10 meters above the ground                                       |
| 22. mixing height | b. measuring 3-dimensional wind fluctuations or associating wind speed, solar insolation, and cloud cover |
| 23. dispersion    | c. performing a thermodynamic analysis of vertical temperature soundings                                  |

24. Which of the following meteorological conditions is (are) associated with poor air quality?
- situations where wind speed and direction rapidly fluctuate
  - periods of heavy precipitation
  - stagnation situations with limited vertical mixing and little advection for prolonged periods
  - consistent winds transporting pollution from a source to the same location for a prolonged period
  - a and d, above
  - c and d, above
25. Which of the following is an (are) averaging time(s) for the PM<sub>10</sub> National Ambient Air Quality Standards?
- 1 hour
  - 8 hour
  - 24 hour
  - 1 year
  - a and c, above
  - c and d, above

# Review Exercise Answers

	<i>Page*</i>
1. e .....	3
2. c .....	3-4
3. False .....	4
4. True .....	4
5. e .....	4
6. True .....	4-5
7. c .....	4
8. d .....	7
9. f .....	13
10. e .....	16-17
11. True .....	25
12. False .....	27
13. c .....	32
14. e .....	32
15. True .....	32
16. True .....	34
17. d .....	35
18. True .....	36
19. True .....	37
20. True .....	37
21. a .....	38

\* Refer to pages 1-43 of EPA-450/4-87-009 *Network Design and Optimum Site Exposure Criteria for Particulate Matter*.

22. c.....	40
23. b .....	38
24. f .....	42
25. f .....	42

## SECTION 1

### INTRODUCTION

The primary purpose of this document is to assist in planning a network of monitoring sites for measuring particulate matter. The measurements will conform to the new PM<sub>10</sub> standard, which replaces the former TSP standard.<sup>1</sup> As a secondary objective, this document will aid in understanding the relationship between PM<sub>10</sub> measurements and the quality of air that is sampled. The information contained here will prove useful to both air quality surveillance personnel and the users of air quality monitoring data. In this document, the siting process is viewed dynamically.

Information received from monitoring sites can be used to feed back into the siting process in order to improve the site selections. The information can also be used to improve air quality simulation models or other analytical tools used in the siting process; however, the process of improving air quality models is not covered in this report.

Monitoring is undertaken to collect needed data. In planning a monitoring network, these data needs must be well defined and understood. This document provides suggestions for helping to identify what these data needs may be. The data needs may change with time as the monitoring results help characterize the local situation and as health effects research clarifies the significant characteristics of air quality exposure. These considerations apply especially to particulate matter, which is made up of highly variable components in space and time.

The major sections of this report treat the following topics:

- Characteristics of PM<sub>10</sub>
- Monitoring objectives
- Elements of site selection
- Methodology for siting PM<sub>10</sub> monitors
- Examples of siting studies.

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<sup>1</sup>. TSP refers to total suspended particulate matter, and PM<sub>10</sub> refers to particulate matter that includes particles in the nominal size range of 10  $\mu\text{m}$  and smaller aerodynamic diameter.

The principal steps in the siting methodology described in Section 5 include the following:

1. Determine needs for monitoring data
2. Assemble and analyze available particulate matter data
3. Model levels of PM<sub>10</sub>
4. Determine PM<sub>10</sub> monitoring network requirements
5. Select location and placement of PM<sub>10</sub> monitors
6. Document and review site selection.

The appendixes include descriptions of sources of data that may be useful in the site selection process.

## SECTION 2

### CHARACTERISTICS OF PM<sub>10</sub>

PM<sub>10</sub> is the indicator for the National Ambient Air Quality Standard (NAAQS) particulate matter, which replaces total suspended particulate matter (TSP). "PM<sub>10</sub>" means particulate matter with an aerodynamic diameter less than or equal to a nominal 10  $\mu\text{m}$ , as measured by the reference method described in Appendix J, 40 CFR 50, and in accordance with 40 CFR 53, or as measured by an equivalent method designated in accordance with 40 CFR 53. In siting monitors for measuring PM<sub>10</sub>, it is desirable to understand the general principles that govern the generation, transformation, and removal of particulate matter; the basic workings of available instrumentation; and the significant factors that control the spatial and temporal patterns of PM<sub>10</sub>.

#### GENERAL PRINCIPLES

Particulate matter as an air pollutant includes a broad class of airborne liquid or solid substances that vary greatly in chemical and physical properties. One important characteristic is size, because larger particles are not collected in the human respiratory tract and are therefore not a health hazard. Because of irregularities in shape, density, composition, and structure of atmospheric aerosols, individual particles are conveniently characterized by their aerodynamic equivalent diameters (AED). Particles with the same fall velocity are defined as having the same AED, which for convenience is specified as the diameter of a uniform sphere with unit density that obtains the fall velocity (e.g., see Corn 1976).

Throughout this document, most references to particle size refer to AED. When the effects of particles on visibility and light scattering are considered, the use of a different definition of particle size more closely related to actual physical size may be necessary. The primary health hazards from particulate matter are due to its deposition in the human respiratory tract. The impact of particle size and chemical composition on the deposition process is discussed in the EPA staff review of the NAAQS for particulate matter (EPA 1981a).

The atmospheric aerosols that make up PM<sub>10</sub> measurements will vary both in size distribution and in chemical composition. Generally, three distinct size modes are present, although the smallest size mode is often difficult to detect. This is shown by the data in Figure 1, which were collected in the California ACHEX study (Whitby 1980). The smallest size mode ( $<0.1 \mu\text{m}$ ) is short-lived and most often observed as a distinct class near combustion sources. The small nuclei (Aitken) mode particles grow rapidly by coagulation into the next largest size mode. The middle size (accumulation) mode particles ( $0.1\text{-}2.5 \mu\text{m}$ ) are formed mainly by coagulation of and vapor condensation on the nuclei mode particles.

The largest coarse size mode particles ( $>2.5 \mu\text{m}$ ) generally make up most of the mass and include particles formed by anthropogenic processes and reentrained surface dust. The two smaller size modes make up what is generally referred to as fine particulate, and the largest size mode is coarse particulate.

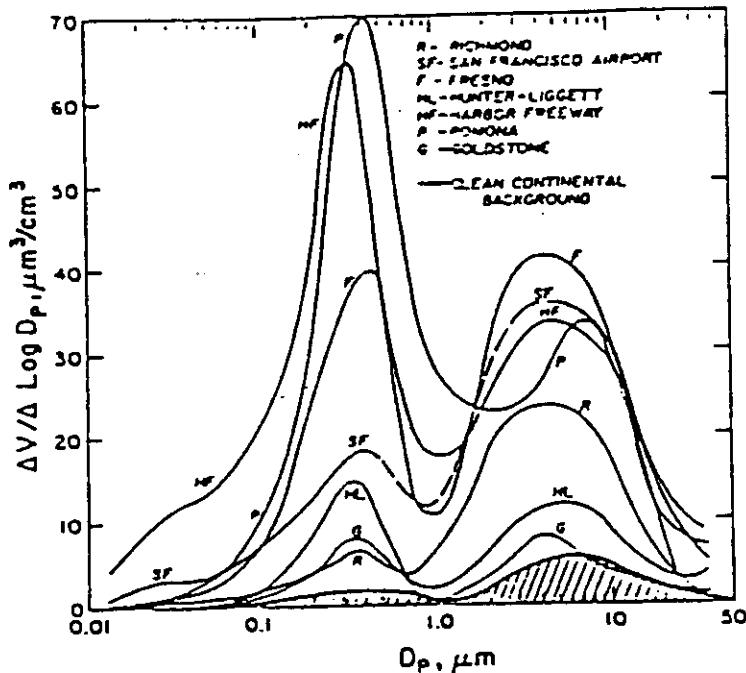


Figure 1. Average volume size distribution for seven sites in the California ACHEX study in 1972 (Whitby 1980).

These two classes, fine and coarse particulates, have different sources and behave independently in the atmosphere. Fine particles mainly result from combustion processes, including the condensation and atmospheric transformation of exhaust gases to form PM. Mechanical processes and wind erosion produce coarse particles. Figure 2 summarizes the principal differences in size and composition of the two types of particles. Fine particles typically consist of sulfates, nitrates, carbonaceous organics, ammonium, and lead. Coarse particles typically consist of oxides of silicon, iron, aluminum, sea salt, tire particles and plant particles.

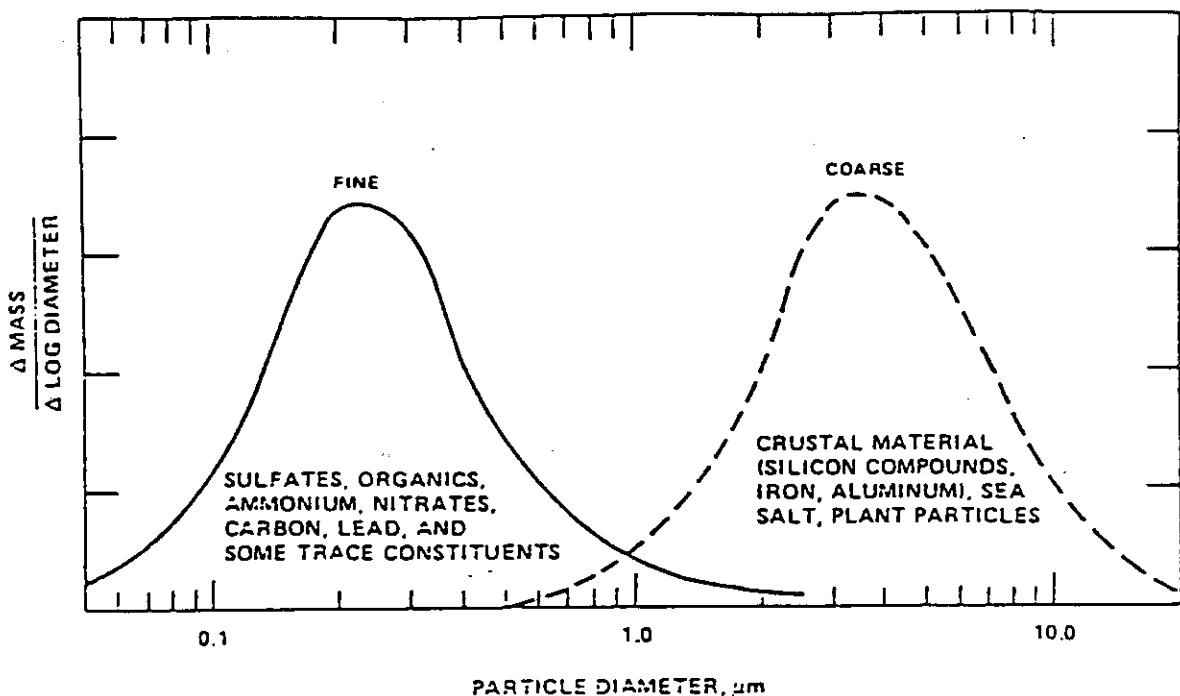


Figure 2. Idealized fine and coarse particle mass distributions (U.S. Environmental Protection Agency 1981b).

Both manmade and natural sources emit atmospheric PM. Natural sources in the United States emit about 84 million metric tons annually, while manmade sources emit 125 to 383 million metric tons annually. Dust, sea spray, wild fires, biogenic emanations, and volcanoes are the principal natural sources. Most of the manmade emissions are fugitives from roads (unpaved and paved), construction activities, agricultural tilling, mining activities, and industrial processes. The emissions are estimated using approximations. Reliable estimates of particle emissions from the combustion of fuel and well-defined sources are also available (see Table 1), but these are estimated to include only about 10 percent of the total manmade emissions. However, almost all of these manmade emissions are fine particles, while the natural and fugitive emissions are coarse particles, of which 50 percent or less are smaller than 10  $\mu\text{m}$ . Most of the sources of coarse particles exist in rural areas where population densities are low.

TABLE 1. NATIONAL ESTIMATES OF PARTICULATE EMISSIONS  
( $10^6$  metric tons per year) (EPA 1981b)

Source category	1940	1950	1960	1970	1975	1978
Stationary fuel combustion	8.7	8.1	6.7	7.2	5.1	3.8
Industrial processes	9.9	12.6	14.1	12.8	7.4	6.2
Solid waste disposal	0.5	0.7	0.9	1.1	0.5	0.5
Transportation	0.5	1.1	0.6	1.1	1.0	1.3
Miscellaneous	5.2	3.7	3.3	1.0	0.6	0.7
TOTAL	24.8	26.2	25.6	23.2	14.6	12.5

The height of release of emissions can have an important bearing on human health. For example, emissions from motor vehicles and home heating in densely populated areas may be as important as emissions from large stationary sources in remote areas. Both types of sources must be taken into account in assessing monitoring sites.

#### INSTRUMENTATION

Until a sufficient data base is developed for PM<sub>10</sub> measurements, most of the information that is available to indicate the nature of particulate matter concentrations will be based on TSP measurements made with high-volume (hi-vol) monitors. Therefore, it is important to understand what hi-vols measure and how this differs from what PM<sub>10</sub> monitors measure. In addition, the advantages and limitations of instruments that use optical reflectance and beta attenuation need to be understood.

#### Hi-Vol TSP Monitors

The hi-vol sampler collects particles on a glass-fiber filter. Air is drawn through the filter at a relatively high flow rate (approximately 1.5 m<sup>3</sup>/min). Although the collection efficiency for larger (>10  $\mu\text{m}$ ) particles is sensitive to wind speed, hi-vols collect essentially all particles less than 25  $\mu\text{m}$  under most conditions. The AED of particles with a 50 percent collection efficiency varies from 25 to 30  $\mu\text{m}$ . However, day-to-day variations in wind speed account for no more than a 10 percent variability in measured

concentrations (EPA 1981b). Under identical meteorological conditions, a typical coefficient of variation is 3 to 5 percent. A more significant problem is the formation of artifact mass caused by the reaction of acid gases with material collected on the glass-fiber filter during a 24-hour sample collection. An estimated 6 to 7  $\mu\text{g}/\text{m}^3$  can be added to a 24-hour concentration measurement by artifacts. Errors may also occur due to loss of volatile particles, deposition on filters before and after sampling, gas reactions after sampling, and filter handling.

#### Potential Reference Method for PM<sub>10</sub>

The reference method for PM<sub>10</sub> is designed to measure that portion of suspended particulate matter in the atmosphere that is likely to be deposited in the thoracic region of the human respiratory tract. The PM<sub>10</sub> reference method has a collection efficiency of 50 percent for particles with 10  $\mu\text{m}$  AED (i.e., D<sub>50</sub> = 10  $\mu\text{m}$ ).<sup>1</sup> The measurement consists of drawing air at a constant rate through a specially shaped inlet that inertially separates particles larger than 10  $\mu\text{m}$  from the sampling stream. The effectiveness of the size discrimination for the 10  $\mu\text{m}$  separation must match the prescribed limits defined by the reference method, or not differ by more than 10 percent in the expected mass concentration measured by a sampler with the ideal size cut efficiencies. The particles contained in each sampling stream are collected on a filter that is weighed (after moisture equilibration) before and after sampling. As with hi-vol sampling, the volume of air sampled is also measured and corrected to EPA reference conditions (i.e., 25° C and 760 mm Hg).

Although the median particle size collection efficiency is the principal characteristic of a PM<sub>10</sub> reference method sampler, a sampler must also meet the following criteria to be a reference method:

- The particle size above which the collection efficiency is less than 50 percent must be within 1  $\mu\text{m}$  of 10  $\mu\text{m}$ .
- The concentration measurements must be reproducible with 15 percent precision.
- The flow rate must be stable to within 10 percent of the initial flow rate over a 24-hour period.

The specific requirements of a PM<sub>10</sub> reference method are given in Appendix J of 40 CFR 50.

<sup>1</sup> The particle size cut, D<sub>50</sub>, of a PM sampler is defined as the particle diameter at which the collection efficiency is less than 50 percent for all larger particles.

$\text{PM}_{10}$  samplers are subject to errors due to loss of volatile particles, artifact PM, nonsampled PM deposition, humidity, filter handling, flow rate variations, and air volume determinations. However, the uncertainties associated with gravimetric measures of particulate matter are less than those associated with particulate measurements based on other principles.

### Other Particulate Matter Measurements

The gravimetric method of measuring PM is limited by the need to (1) accumulate an adequate mass for detection by use of an analytical balance, (2) condition the filter for moisture content, (3) separate the collection time from the mass assessment time, and (4) handle the sample between collection and assessment. To eliminate these disadvantages, optical sensing and beta attenuation measurement principles can be used. However, measurements based on these principles do not measure mass directly and may produce variable concentration estimates when certain properties of the particles vary (e.g., particle size distribution or carbon content).

A commonly used instrument based on optical sensing is the tape sampler. Particles are collected to form a stain on a paper tape filter, which is periodically advanced. The transmittance of light through the stain is measured to determine the optical density or coefficient of haze (COHS). The COHS units at a given site may be calibrated to mass measurements made with colocated gravimetric device. The tape sample is capable of finer time resolution and faster readout time than gravimetric sensing methods. For certain purposes, including response to severe pollution buildups that require a rapid update of information, optical sensing may be a necessary alternative to gravimetric sensing.

It is also possible to measure specific properties of collected samples. Such properties may include sulfate and nitrate components, visibility reduction, and specific elemental components. The need for information other than mass concentration of PM should be defined when monitoring operations are planned and factored into siting considerations. Samples taken for mass concentration measurements usually can be used for other purposes, because the mass measurement techniques preserve the samples.

### USE OF AVAILABLE DATA TO DRAW INFERENCES ABOUT $\text{PM}_{10}$ LEVELS

Because of the abundance of TSP data and the limited quantity of  $\text{PM}_{10}$  data available, it may be necessary to use TSP or other available measures of PM to determine expected patterns of  $\text{PM}_{10}$ . EPA has published a document examining relations of  $\text{PM}_{10}$  to other particulate matter (Procedure for Estimating Probability of Nonattainment of  $\text{PM}_{10}$  NAAQS Using TSP or  $\text{PM}_{10}$  Data). The details of this procedure are beyond the scope of this document; however, a few conclusions from this report are provided.

The ratio of  $\text{PM}_{10}$ /TSP was examined at sites consisting of collocated  $\text{PM}_{10}$ /TSP sites operating in 1982 and 1983 for the purpose of establishing a simple ratio which would permit the direct adjustment of TSP to  $\text{PM}_{10}$ . However, upon scrutinizing the data base, it was clear that a substantial degree of variability existed amongst individual ratios. (The IP/TSP ratios were also examined, only to

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establish that they confirmed the PM<sub>10</sub>/TSP analyses.) This variability includes inter- as well as intrasite differences in the ratios. As described elsewhere in the document, the PM<sub>10</sub>/TSP ratio was also found to be somewhat sensitive to TSP concentrations. This sensitivity is diminished by focusing on site-days observed TSP > 100 ug/m<sup>3</sup> or, in the case of annual analyses, site-years with TSP > 55 ug/m<sup>3</sup>.

Several attempts were also made to find an explanatory site descriptor which could account for the disparity in the ratios among sites (i.e., inter-site variability). In the first attempt, such site descriptors as urban versus suburban were compared; however, no statistically significant difference was found. Geographic area (East, Southwest, West Coast, etc.) and site type (industrial, commercial or residential) likewise revealed insignificant differences in the ratios. In a more recent and more extensive investigation of geographic differences performed on the entire 1982 and 1983 data base, statistically significant differences were found among individual sites as well as among larger groupings of sites. However, the differences among larger groupings of sites are smaller and are difficult to explain on a physical basis. These investigations conclude that unless sufficient data to calculate a site specific PM<sub>10</sub>/TSP ratio are available, the existing data base does not justify use of different distributions of ratios for different parts of the country.

The previously described investigations of geographic, climatological, concentration range, or site type classifiers were attempts to reduce or account for part of the variability in PM<sub>10</sub> to TSP ratios. No doubt, a part of the overall variance in ratios results from intra-site variation in ratios arising from differences in the sources impacting the monitor site. As discussed in other sections of the document, there are several issues associated with the precision of the TSP and PM<sub>10</sub> measurements which affect intra-site variance. These factors include windspeed dependence, weighing problems, artifact formation and sampler wall losses. Thus, the inter-site variance can potentially be eliminated by the use of site specific data, but the intra-site variance can only be partially reduced by careful operating procedures.

The variance among PM<sub>10</sub>/TSP ratios suggests the need to examine the frequency distribution of ratios rather than relying on a single value for the ratio. The cumulative frequency distribution for PM<sub>10</sub>/TSP is presented in Figure 3 for site average (arithmetic mean) ratios. Figure 4 contains a similar distribution for 24-hour ratios.

#### SPATIAL/TEMPORAL PATTERNS

National spatial and temporal patterns of PM<sub>10</sub> have been deduced from a variety of available PM observations. Sections 3 and 4 of this document contain guidelines for estimating these patterns in local areas. Important factors that influence the patterns are the sources of emissions, topography and other physiographic factors, and meteorology. Figure 5 shows an indication of the variation in concentrations that can be expected with season of the year and with rural, suburban, and urban location. These graphs are based on monitoring data from a small number of sites.

Cumulative Percentage of Ratios Greater Than a Given Value (Annual)

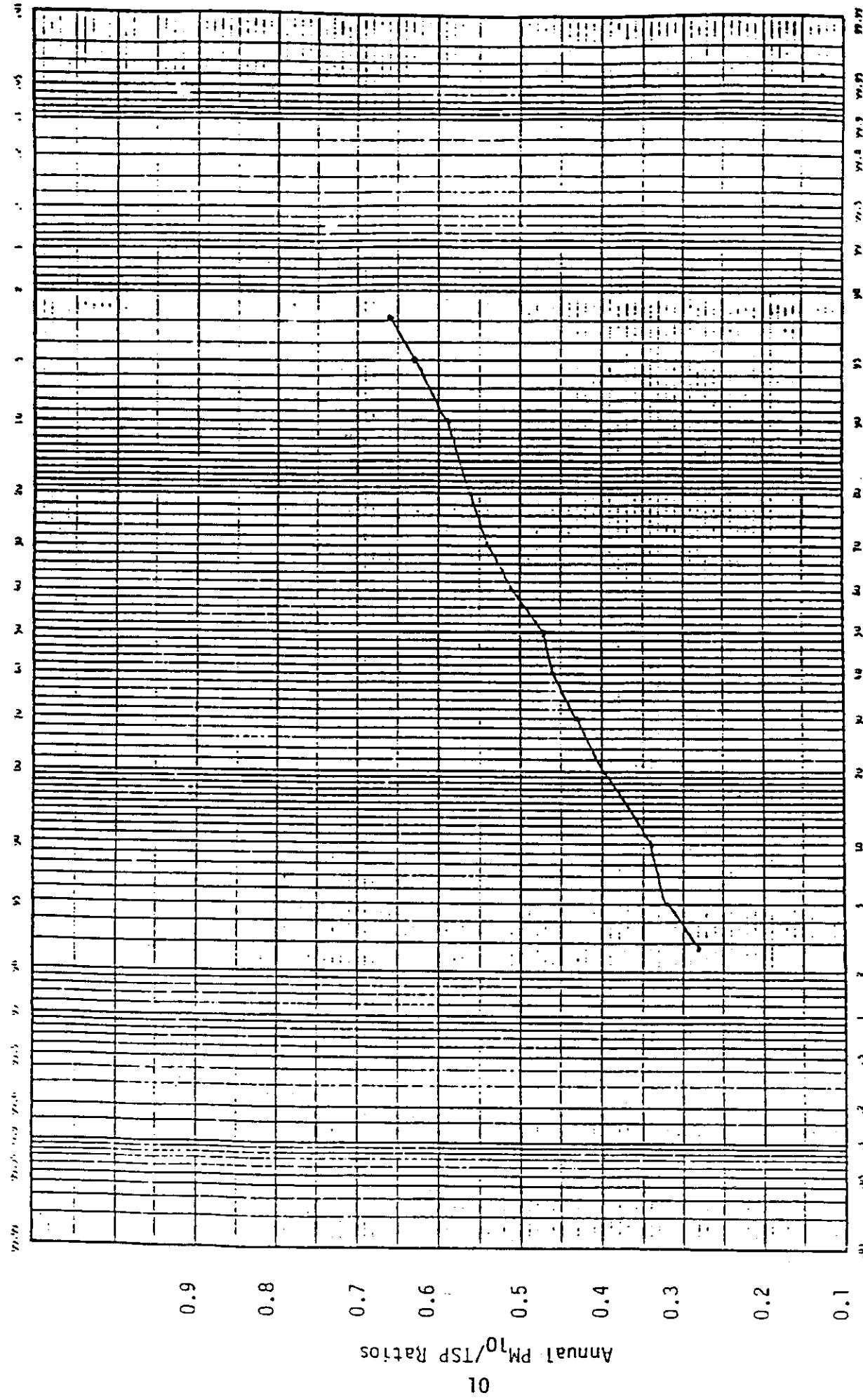
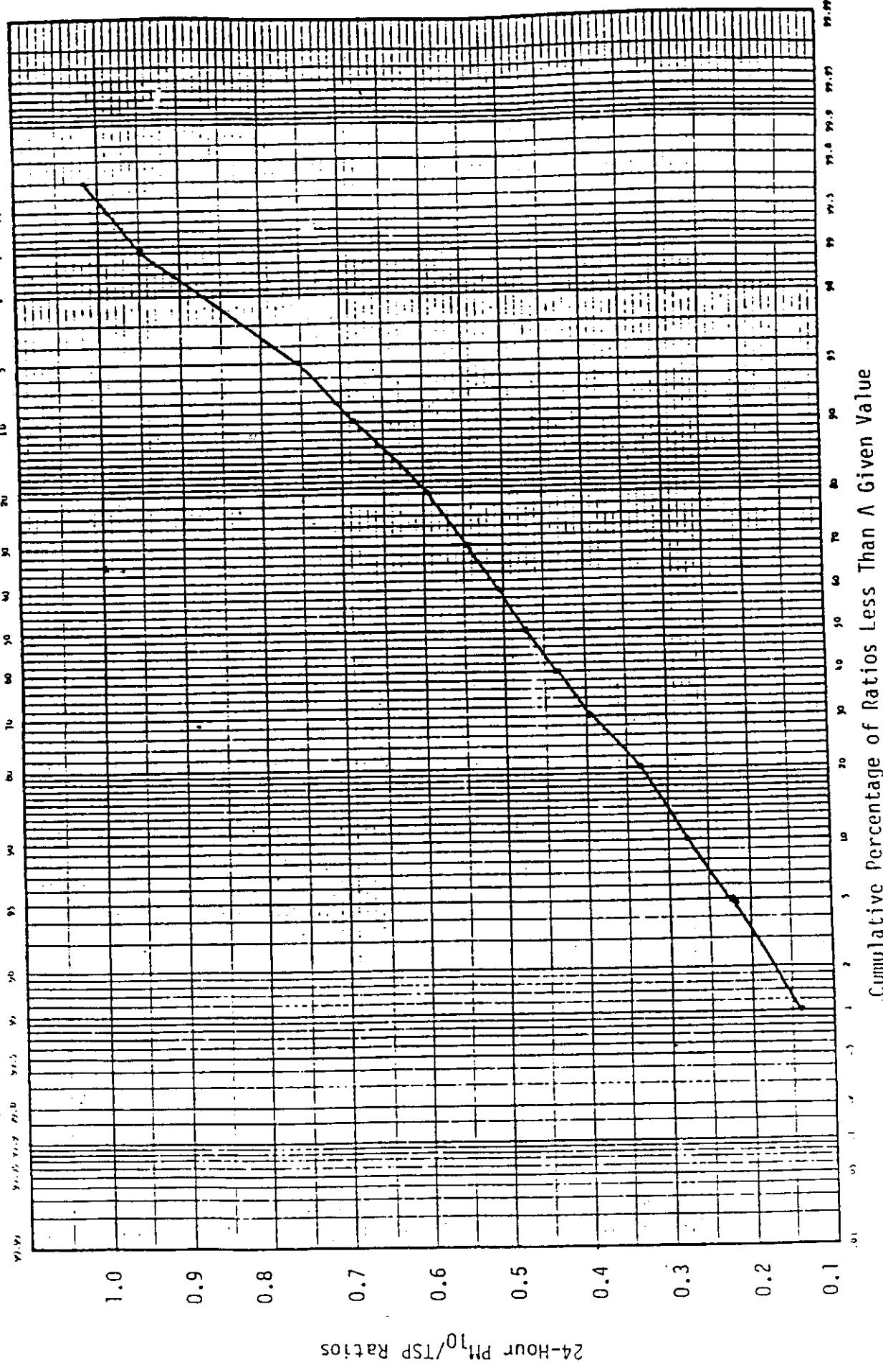


Figure 3. Distribution of Annual PM<sub>10</sub>/TSP Ratios

Cumulative Percentage of Ratios Less Than A Given Value (Annual)

Figure 3. Distribution of Annual  $\text{PM}_{10}/\text{TSP}$  Ratios

Cumulative Percentage of Ratios Greater than  
A Given Value (24-hour)



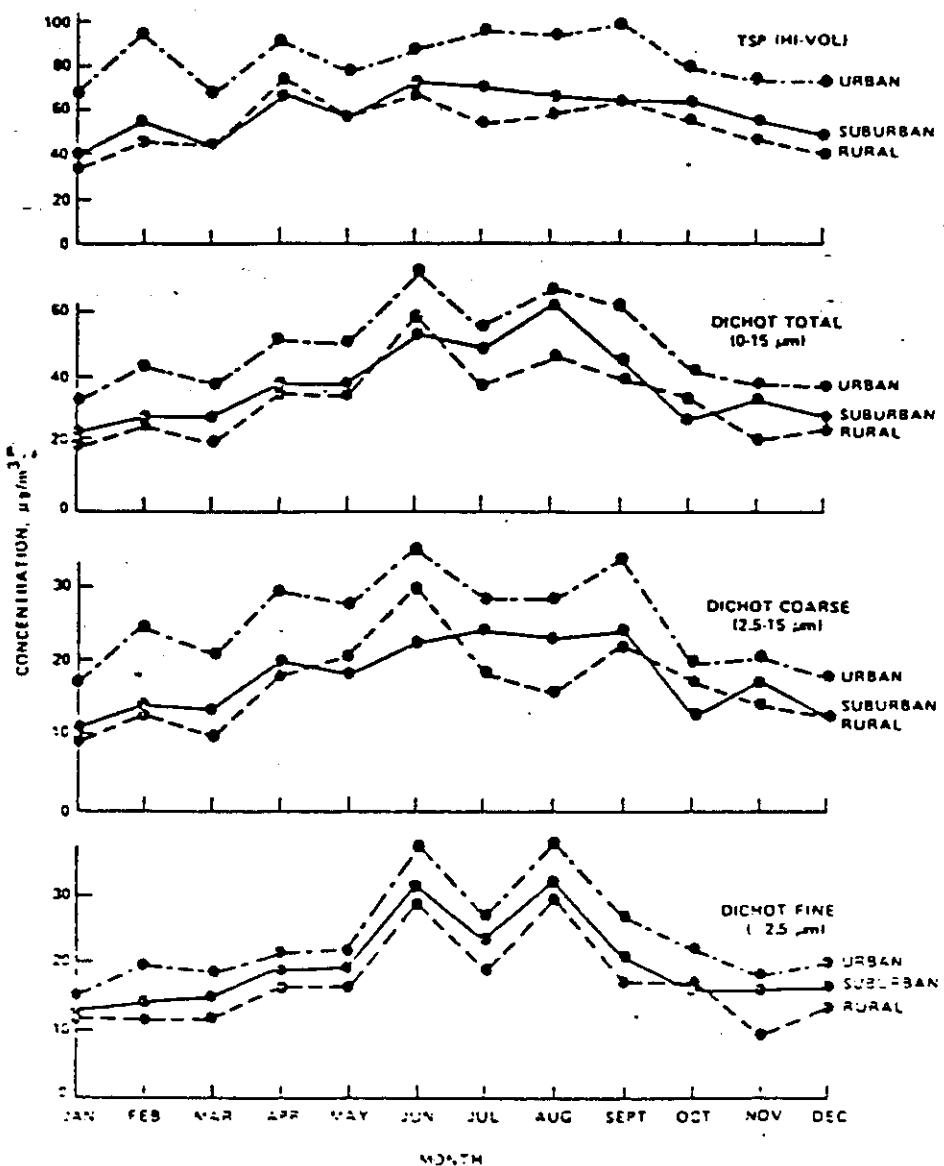


Figure 5. Seasonal variations in urban, suburban, and rural areas for four size ranges of particles.

Source: After Trijonis et al. (1980).

### Influence of Sources

The highest TSP values are found in dusty arid regions and in industrialized cities. Table 2 shows a breakdown of the principal categories of sources that comprise the EPA national inventory of particulate emissions. The much larger fugitive emissions from nonindustrial anthropogenic activities, such as travel on unpaved roads and wind-eroded farmland, are not included in these figures. These indirect fugitive emissions are coarse particles, and less than 50 percent of their mass will be less than 10  $\mu\text{m}$  in diameter. Furthermore, the sources are widely dispersed and not concentrated near populated areas.

Most of the interest in controlling and monitoring particulate emissions focuses on the stationary sources listed in Table 2. These emissions are believed to contain more toxic elements and to consist primarily of fine particles. Fugitive dust emissions from stationary sources are of particular concern, because they exceed stack emissions, are emitted near ground level, and contain more toxic materials than soils from farmlands and unpaved roads away from industrial sources.

### Influence of Atmospheric Processes

PM emitted into the atmosphere is transported by the wind and diluted by various atmospheric turbulence and mixing processes. In addition, particles are removed by dry and wet deposition processes. Particles remaining airborne may grow by condensation, coagulation, and chemical reactions; these growth processes are enhanced by the accumulation of moisture. Figure 6 summarizes and graphically illustrates many of these various atmospheric processes.

Secondary pollutants, which form and grow due to these atmospheric processes, are a major component of PM concentrations. Sulfates, formed primarily by atmospheric reactions, often account for 40 percent of the fine particles. Because fine particles typically contribute about one-third of TSP mass and because  $\text{PM}_{10}$  is expected to equal about 50 percent of the TSP levels, it is reasonable to expect the sulfate contribution to equal about 25 percent of  $\text{PM}_{10}$  measurements. But on many occasions the total contribution of secondary PM to  $\text{PM}_{10}$  measurements may be considerably higher than 25 percent. Because the formation of secondary PM requires time, the principal sources are likely to be remote from the point where they are measured. This makes it important to measure  $\text{PM}_{10}$  concentrations upwind of urban areas, as well as within and downwind of the areas of concern. The formation of sulfates and nitrates is sufficiently active in both summer and winter to produce high contributions to  $\text{PM}_{10}$  measurements. The formation of organic aerosols is also important; observed 24-hour concentrations have reached as high as  $100 \mu\text{g}/\text{m}^3$ .

TABLE 2. SUMMARY OF NATIONAL 1985 PARTICULATE MATTER EMISSIONS BY SOURCE CATEGORY (EPA 1987)

Source Category	1985 Emissions (10 <sup>3</sup> tons)
Coal-fired electric utility boilers	627
Coal-fired industrial boilers	132
Integrated iron and steel plants and coke ovens*	187
Portland cement plants	286
Primary nonferrous smelters#	44
Solid waste disposal plants	110
Kraft Pulp and paper mills	110
Asphalt batching plants	132
Concrete lime and gypsum	99
Iron and steel foundries	44
Subtotal for selected source categories	1771
Stationary sources§	6600
Mobile sources	1430
All sources	8030

\* Includes emissions from materials handling and storage piles.

# Includes fugitive process emissions and emissions from ore crushing and materials handling.

§ By difference between all sources and mobile sources.

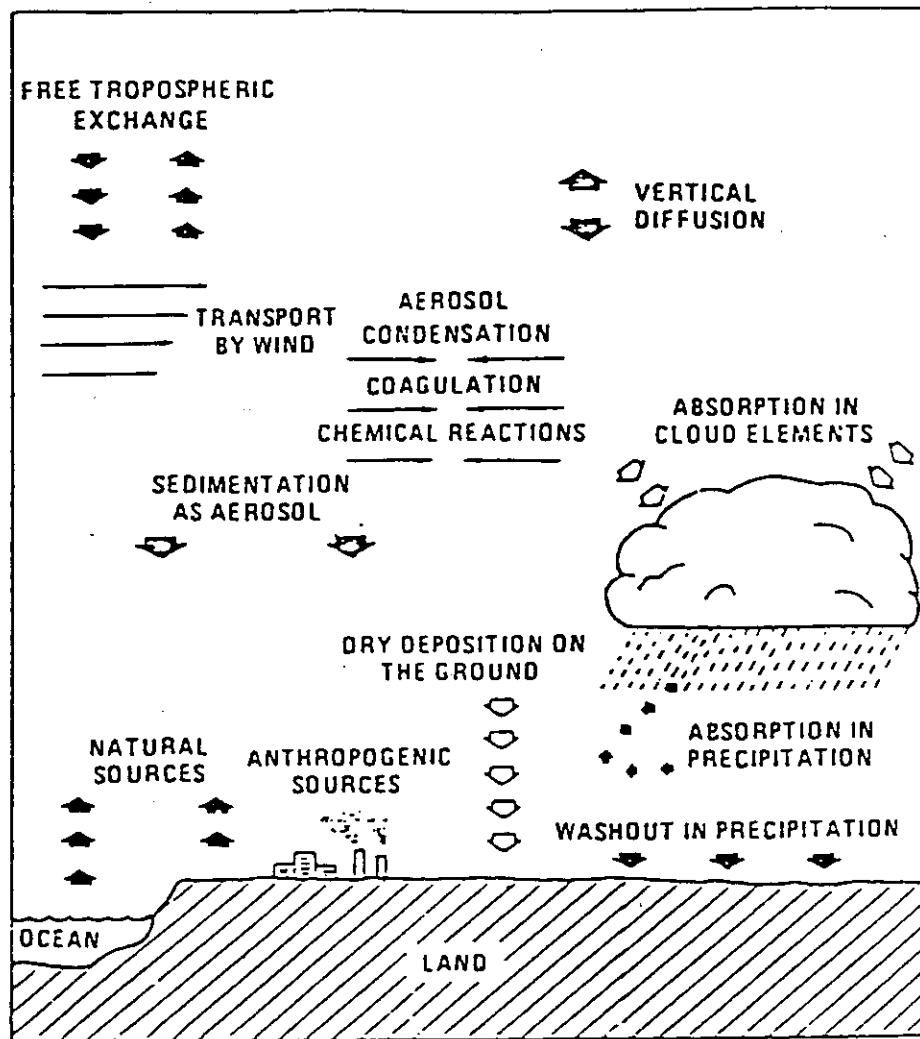


Figure 6. Complex processes affecting transport and transformation of airborne particulate matter.

Source: Adapted from Drake and Barrager (1979).

## SECTION 3

### MONITORING OBJECTIVES FOR PM<sub>10</sub>

Two pressing questions arise in planning a monitoring program. How many monitors are required? And where should they be located? The answers affect the allocation of resources that, particularly in operational settings, ultimately shape the final program.

Due to a wide diversity of topography, population distribution, source locations, and climates, ambient air quality monitoring regulations and policies rarely specify the number and location of monitors. But regardless of the influence of physical factors, the specifications for a monitoring network strongly depend upon the monitoring objectives.

A monitoring objective relates the monitoring mandate to spatial/temporal variations in sources of pollution, meteorology, and receptors of pollution. The monitoring mandate arises from specific needs and uses for data. A monitoring objective is the link between the goals of the mandate and appropriate siting opportunities in the monitoring scene. Monitoring objectives relate program objectives that concentrate upon end uses for the collected data and physical objectives that concentrate on the temporal and spatial character of representative sampling.

One obvious use of PM<sub>10</sub> data lies in establishing environmental regulations and policies. Such regulatory mandates are rooted in the Clean Air Act (CAA) and other Federal, state, and local regulations that specify air quality requirements.

Other data uses satisfy research needs and support public services. A variety of data uses for the criteria pollutants have been summarized in other EPA monitoring guidelines (Ball and Anderson 1977; Ludwig and Kealoha 1975; Ludwig, Kealoha, and Sholar 1977; Ludwig and Sholar 1978) and elsewhere (e.g., EPA 1977a). Table 3 summarizes these varied data uses:

- Evaluation of ambient air quality
- Enforcement of source-specific regulations
- Evaluation/development of control plans
- Air quality maintenance planning
- Protection of public health
- Development and testing of models
- Research.

TABLE 3. PRINCIPAL DATA USES FOR PM<sub>10</sub>

- 
1. Evaluation of Ambient Air Quality
    - Judging Attainment of NAAQS
    - Establishing Progress in Achieving/Maintaining NAAQS
    - Establishing Long-Term Trends
  2. Enforcement of Source-Specific Regulations
    - Categorical Sources (ESEA, SCS, PSD)
    - Individual Sources
    - Enforcement Actions
  3. Evaluation/Development of Control Plans
    - SIP Provisions
    - Evaluation/Development/Revision of Local Control Strategies
  4. Air Quality Maintenance Planning
    - Establishing Baseline Conditions
    - Project Future Air Quality
  5. Protection of Public Health
    - Air Quality Indices
    - Documentation of Population Exposures
    - Response to Unique Citizen Complaints
    - Development/Revision of Standards
  6. Development and Testing of Models
    - Input for Receptor Models
    - Validation and Refinement
    - Assessing Representativeness of Monitoring Networks
  7. Research
    - Effects on Humans, Plants, Animals and Environment
    - Characterization of Source, Transport, Transformation, and Fate for Anthropogenic and Natural Emissions
    - Development/Testing of New Instrumentation
-

The order of the listed uses does not represent any sense of priority. The uses are a composite of diverse program objectives that would require extended discussion to develop in detail.

In all areas except research, a straightforward relationship exists between mandate and program objectives or data uses. Thus these representative data uses provide a range of example situations, so that physical objectives for specific cases not covered here can be developed by analogy.

#### EVALUATION OF AMBIENT AIR QUALITY

The National Ambient Air Quality Standard for PM<sub>10</sub> stipulates acceptable air quality in terms of a 24-hour criteria level (not to be exceeded more than the specified number of times a year) and an annual criteria level (the 12-month arithmetic mean). Although the NAAQS is the principal standard that must be met, other local and state agencies may set standards that must be met.

Compliance with the NAAQS is a fundamental goal of ambient air quality control strategies (particularly for State Implementation Plans (SIPs)) and forms the basis for air quality maintenance planning, policy development, and additional regulation. Data are needed to evaluate ambient air quality and detect compliance with the NAAQS. Attainment status is conferred upon an area, based on the expectation that the NAAQS criteria levels are not violated. Therefore, the monitoring objectives are geared to acquiring measurements that represent conditions throughout the area in question, the underlying context being that air quality levels elsewhere in the area are no worse than those indicated by the measurements.

The data are also used to demonstrate reasonable progress toward attainment for areas in violation of the NAAQS, document baseline conditions for environmentally sound expansion and development, and depict long-term trends.

#### ENFORCEMENT OF SOURCE-SPECIFIC REGULATIONS

Under some circumstances, major air pollution sources are allowed to operate under demonstration that their emissions do not cause ground-level concentrations that exceed a specified criteria level. The criteria level is ordinarily tied to NAAQS, but may be tied to other criteria. These situations may prevail for power plants, coking facilities, and other categorical sources under a variety of regulations. Source-specific regulations may consist of tailored or negotiated agreements that are integrated to implementation plans on a source-by-source basis. Although the responsibility to monitor may fall upon a regulatory agency or upon the source management, the objective is to measure the impact of a known source.

Indications of compliance/noncompliance are often used in enforcement proceedings and frequently form the basis for litigation and negotiation. A corollary monitoring situation entails isolating an offending source or family of sources when an adverse impact is measured.

Many applications require a long-term, continuing monitoring program. However, in some enforcement situations, a relatively short sampling program or a periodic survey approach is applicable.

#### EVALUATION/DEVELOPMENT OF CONTROL PLANS

Government monitoring agencies and pollution source operators are actively concerned with gaining/retaining NAAQS attainment status. Procedures for pursuing this goal are stated in the SIP, which is expanded and modified as needed.

Monitoring data are needed for the following purposes:

- Define nonattainment areas
- Develop control policies and strategies
- Define nondeterioration areas
- Develop air pollution emergency episode plans.

The monitoring data are used to demonstrate and characterize the need for controls. The demonstration may identify categorical sources or specific sources. Nondeterioration areas and areas subject to growth or economic rejuvenation require monitoring to define the baseline conditions.

Monitoring data are needed in areas subject to extremely high concentrations to identify the onset and abatement of episodes. A separate guidance document on the timely reporting of PM<sub>10</sub> concentrations during emergency episodes is available (EPA 1983).

#### AIR QUALITY MAINTENANCE PLANNING

Planning agencies and developers from the private sector require monitoring data to determine baseline air quality levels in locations of projected growth and expansion. These data may be critical in determining whether such activity will meet Prevention of Significant Deterioration (PSD) requirements in attainment areas or interfere with progress toward attainment of NAAQS in nonattainment areas. Siting considerations need to consider whether special sites are needed to meet these data needs or whether the nearest available monitoring will be adequate.

## PROTECTION OF PUBLIC HEALTH

It can be argued that all air quality monitoring is ultimately oriented to public health. Air quality indices keep the public apprised of current levels of air pollutants. The siting requirements to meet the data use need to be coordinated with needs for emergency episode data and for ambient air quality evaluations. A second category of public health oriented data use involves documentation of population exposures. This may require a specially sited network designed to estimate personal exposures in connection with epidemiological studies. Special monitoring sites may also be required to respond to unique citizen complaints. These frequently involve sources and impacts that are not part of operational coverage.

## DEVELOPMENT AND TESTING OF MODELS

Monitoring requirements to support model development or testing are generally unique for each project. This is particularly true for model development support where the objective is to describe and understand the ongoing processes or to develop parameter values representative of a specific terrain, meteorological condition, or source configuration. As a general rule, monitoring for model development must be intensive and flexible to provide the maximum benefit. Measurements are desired that are as tightly spaced and as frequently recorded as are compatible with economic restraints. However, the monitoring equipment should be mobile enough so that it can be moved as conditions change or as analyzed information indicates a need for information from different locations.

The primary emphasis is on demonstrating that the model being tested adequately estimates the highest concentrations. This means that monitoring data needs to be taken at locations downwind of major sources during critical meteorological conditions. The data record needs to be sufficiently long to truly characterize the data site--usually a minimum of 1 year--if the model is to demonstrate validity at the test site. Test data, preferably from a different locality, must be independent of data used to develop the model. The placement and number of monitors will depend on meteorological conditions, topography, source characteristics, and purpose of the model. Sections 4 and 5 of this report provide further suggestions with respect to these influences.

## RESEARCH

Monitoring data is needed to support research allied to PM<sub>10</sub> questions in order to improve the scientific tools for measurement, interpretation, and prediction. Monitoring sites selected to support research may coincide or

supplement other monitoring requirements. Research needs in the following areas may be considered when selecting sites:

1. Effects on humans, plants, animals, and environment
2. Characterization of source, transport, transformation, and fate for natural and anthropogenic emissions
3. Development and testing of new instrumentation.

## SECTION 4

### ELEMENTS OF SITE SELECTION

The site selection procedures offered in Section 5 rely primarily on inferred and demonstrated associations among PM<sub>10</sub> sources, meteorology, and a number of physical factors such as topography and land use. Important outcomes (i.e., ambient concentrations) can vary tremendously from place to place within a monitoring scene and from time to time at a given place. From a useful perspective, any area to be monitored is going to be too complex to bring all structures into focus at once. The concept of representative scale is a useful way to characterize these variations on a physical basis that can be related to comprehensible patterns.

#### REPRESENTATIVE SCALES

The concept of representative spatial scale is used to define a characteristic distance over which pollutant concentrations are uniform or nearly so. As a corollary, we can define homogeneous areas in which measurements performed in the relatively small air volume near a sampler (nominal horizontal extent of 1 meter) can represent conditions prevailing over some much larger area.

Representative spatial scales illustrated in Figure 7 have been previously identified (EPA 1979) and are compatible with spatial scales of source areas. We shall be concerned with the following spatial scales:

- Microscale--ambient air volumes ranging in horizontal extent from a few meters to as much as 100 m. The microscale encompasses the immediate vicinity of the monitor. In the immediate presence of PM<sub>10</sub> sources, exposure may in reality be only representative of the microscale. For this reason, the microscale is the final judgmental factor in site selection (see Section 5) and requires a site visit to make this appraisal, because maps rarely portray confounding influences in sufficient detail.
- Middle scale--ambient air volumes covering areas larger than microscale but generally no more than 0.5 km in extent. In settled areas, this may amount to several city blocks. As will be shown later, this is essentially the lower limit of resolution for most models.
- Neighborhood scale--ambient air volumes whose horizontal extent is generally between 0.5 and 4 km. The neighborhood scale is aptly named. It is useful in defining extended areas of homogeneous land use.

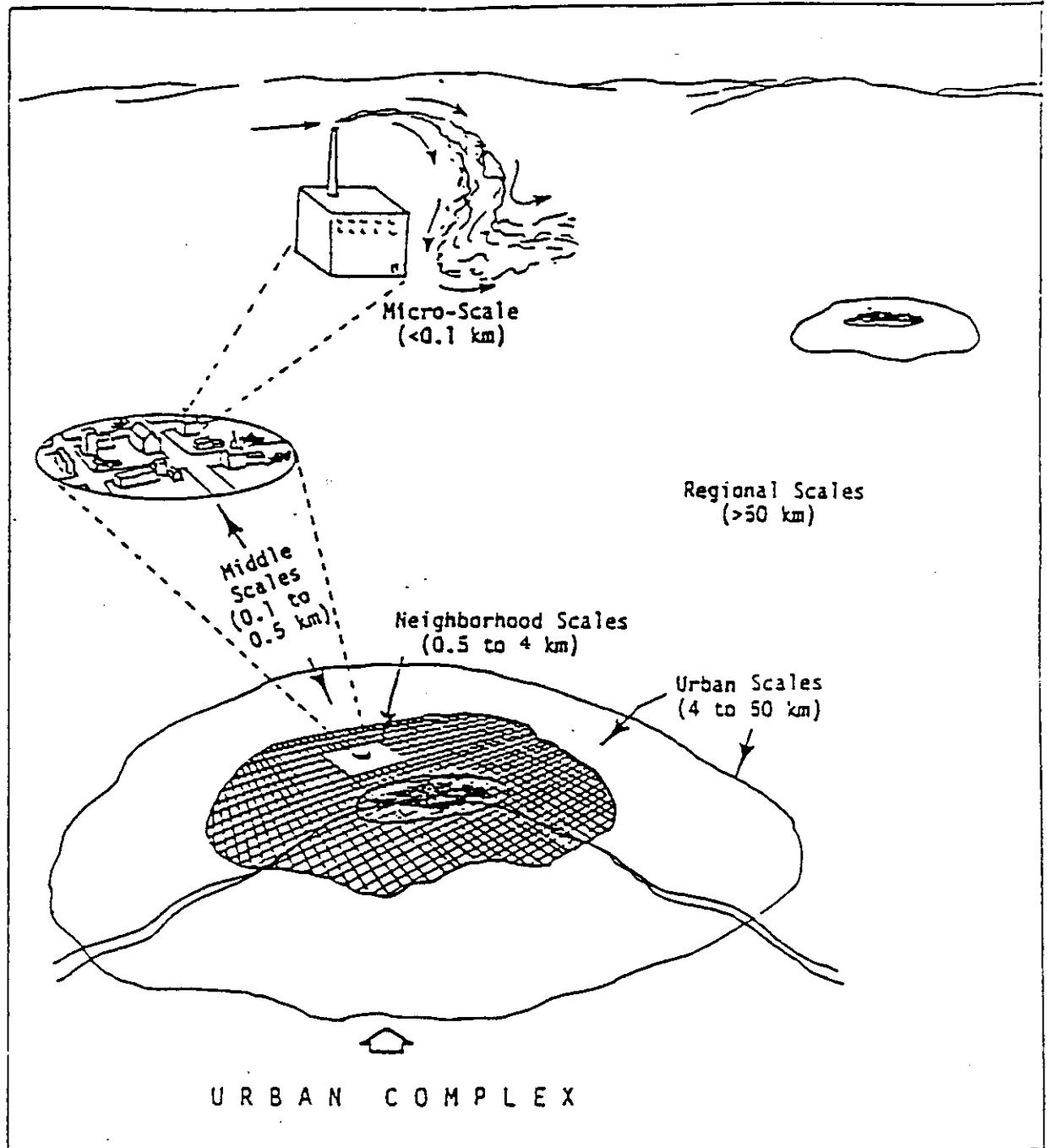


Figure 7. Illustration of various spatial scales of representativeness (Ball and Andersen 1977).

- Urban scale--ambient air volumes whose horizontal extent may range between 4 and 50 km. This is frequently the most desirable representative spatial scale, because it captures an entire urban area. However, the diversity of sources that prevail within such areas argue against homogeneity at this scale.
- Regional scale--ambient air volumes whose horizontal extent ranges from tens of kilometers to hundreds of kilometers. Monitors that are unaffected by specific sources or by localized groups of sources can be representative at this scale.
- National and global scales--seek to characterize air quality from a national perspective (thousands of kilometers) or from a global perspective (tens of thousands of kilometers).

Although all of the above scale intervals may be needed to subdivide a monitoring scene, the neighborhood scale in urban settings and the regional scale in substantially unsettled areas are particularly practical scales for spatial coverage by a single monitor. In many circumstances, the representativeness of the small scales must be estimated by networks composed of a limited number of sites.

#### ANALYSIS OF THE AREA TO BE MONITORED

The primary intent of the analytical process that supports site selection is to characterize pollutant levels within the area to be monitored. This requires information regarding the location of important sources of PM<sub>10</sub>, a description of atmospheric trajectories to trace the movement of PM<sub>10</sub>, and estimates of dispersion accompanying such movement. These reflect a complex interplay among topography and climatology that must be cast into time frames that are compatible with the NAAQS. Three components for analysis are as follows:

- Regional dispersion climatology--to assemble the basis for transport/dispersion patterns that may be applied to the area to be monitored as a whole
- Physical differentiation--to assemble the basis for identifying distortions of simple source/receptor relationships due to local alterations of trajectory and dispersion
- Emissions configuration--to assemble the basis for identifying relevant PM<sub>10</sub> sources and recognizing useful patterns.

An area of interest with respect to air quality is usually defined by political boundaries, such as state, county, city, or air quality control region lines. A method of systematically characterizing the area to be monitored into homogeneous areas of air quality levels that are potential locations of air pollution monitoring sites requires that sources of particulate emissions, patterns of terrain and physiography, and climatology be taken into account. A method and data sources for performing such a classification analysis for ambient concentrations of PM have been developed in this study beginning with a description of the three categories of influencing factors. The methodology is presented in Section 5.

### Emissions Configuration

The emissions configuration is simply the spatial/temporal distribution of sources throughout the monitoring scene; in concept, it will consist of one or more maps delineating areas of similar source characteristics. Depending on the mix of sources and local/regional climate, such maps will depict relevant seasonal and diurnal emissions patterns in terms of relative intensities and release heights.

In concept, the most straightforward approach to generating maps would be to selectively allocate the elements of a formal emissions inventory to a suitably detailed grid. In practice, this is not a trivial task; even an automated approach carries a substantial burden in data management and manipulation. Though difficult, this approach has merit because it develops highly usable data for subsequent computerized modeling.

An alternative approach is to proxy these source areas by patterns of land use. In most urban areas, planning agencies have compiled information that can form the basis for categories of near-surface emission. In the absence of such information, relatively unsophisticated interpretation of aerial photographs can be helpful. Table 4 offers a land use classification that is amenable to this approach. Emission factors can be assigned to each land use classification based on consideration of local heating fuels, climate, and census data in housing and population densities. In addition, large point sources (e.g., 1000 tons per year) should be separately identified.

The first use of an emissions configuration is in a semiquantitative or subjective mode. The orientation of key impact zones can be surmised with the aid of appropriate wind roses. Areas likely to be inundated by several sources can be identified.

An emissions inventory provides important information to the site selection process by identifying significant point and area sources and cataloging emissions in terms of location, source strength, operating characteristics, etc. The National Emissions Data System (NEDS), for instance, identifies individual point sources that release 100 tons per year or more

TABLE 4. IDENTIFICATION AND CLASSIFICATION OF LAND USE TYPES (AFTER AUER 1978)

Type	Use and structures	Vegetation
I1	<b>Heavy Industrial</b> Major chemical, steel, and fabrication industries; generally 3- to 5-story buildings, flat roofs	Grass and tree growth extremely rare; <5% vegetation
I2	<b>Light-Moderate Industrial</b> Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1- to 3-story buildings, flat roofs	Very limited grass, trees almost totally absent; <5% vegetation
C1	<b>Commercial</b> Office and apartment buildings, hotels; >10-story heights, flat roofs	Limited grass and trees; <15% vegetation
R1	<b>Common Residential</b> Single-family dwelling with normal easements; generally single-story, pitched-roof structures; frequent driveways	Abundant grass lawns and light to moderately wooded; >70% vegetation
R2	<b>Compact Residential</b> Single- and some multiple-family dwellings with close spacing; generally <2-story, pitched-roof structures; garages (via alley), no driveways	Limited lawn sizes and shade trees; <30% vegetation
R3	<b>Compact Residential</b> Old multifamily dwellings with close (<2 m) lateral separation; generally 2-story, flat-roof structures; garages (via alley) and ashpits; no driveways	Limited lawn sizes, old established shade trees; <35% vegetation
R4	<b>Estate Residential</b> Expansive family dwelling on multiacre tracts	Abundant grass lawns and lightly wooded; >95% vegetation
A1	<b>Metropolitan Natural</b> Major municipal, state, or Federal parks, golf courses, cemeteries, campuses; occasional single-story structures	Nearly total grass and lightly wooded; >95% vegetation
A2	<b>Agricultural Rural</b>	Local crops (e.g., corn, soybeans) >95% vegetation
A3	<b>Undeveloped</b> Uncultivated; wasteland	Mostly wild grasses and weeds, lightly wooded; >90% vegetation

of five criteria emissions (particulate matter, SO<sub>x</sub>, NO<sub>x</sub>, CO, hydrocarbons) as well as area sources aggregated at the county level (i.e., all other stationary sources that individually emit less than 100 tons per year and all mobile sources). More detailed approaches (e.g., Pace 1979) develop microinventories that add perspective and structure to the area source category.

It is beyond the intended scope of this report to promote methodologies for constructing emission inventories. For the purposes at hand, an emissions inventory for particulate matter emissions is assumed to be available and ready for use. Such an inventory may be composed of NEDS-based data (EPA 1984) or may have been specially constructed for the monitor siting analysis.

During the last few years EPA has had PM<sub>10</sub> emission factors developed for a large number of source categories. The development of PM<sub>10</sub> emission factors for additional source categories including some fugitive and open sources is still in progress at this time. The user is referred to EPA's Compilation of Air Pollution Emission Factors AP-42 for specific emissions by source category and specific methodology for their use in developing emission estimates. The compilation provides specific factors not only by general source category but also for each processing step within a category. Tables 5 and 6 present example emission factors for some selected source categories. These examples have been taken from EPA's report.

### Terrain and Physiography

The patterns of ambient concentrations that occur due to the transport and diffusion of pollutants over open and flat terrain are significantly distorted by irregularities in the terrain and other features of physiography. Two major factors in this regard are as follows:

- Aerodynamic diversion--flow around and over obstacles. Distortion of the flow field may be severe during moderate to strong synoptic winds.
- Local circulations--mountain-valley winds, land-sea breezes, and the like that may prevail when synoptic influences are sufficiently weak. Under these conditions, flow patterns within the scene may "wall off" subareas. Transport and dispersion estimates at one place are unlikely to reflect air motions elsewhere.

TABLE 5. CUMULATIVE PARTICLE SIZE DISTRIBUTION AND SIZE SPECIFIC EMISSION FACTORS FOR SPREADER STOKERS BURNING BITUMINOUS COAL<sup>a</sup>

EMISSION FACTOR RATING: C (uncontrolled and controlled for multiple cyclone without flyash reinjection, and with baghouse)  
 E (multiple cyclone controlled with flyash reinjection, and ESP controlled)

Particle size <sup>b</sup> (μm)	Cumulative mass % ≤ stated size				Cumulative emission factor (kg/Mg (lb/ton) coal, as fired)				
	Uncontrolled		Controlled		Uncontrolled	Controlled			
	Multiple cyclone <sup>c</sup>	Multiple cyclone <sup>d</sup>	ESP	Baghouse		Multiple cyclone <sup>e</sup>	Multiple cyclone <sup>f</sup>	ESP	
15	28	86	74	97	72	0.4 (16.4)	7.3 (14.6)	0.23 (0.44)	0.043 (0.004)
10	20	73	65	90	60	4.0 (12.0)	6.2 (7.8)	0.22 (0.44)	0.036 (0.002)
6	14	51	52	82	46	4.2 (8.4)	4.3 (8.6)	0.20 (0.40)	0.026 (0.004)
2.5	7	8	27	61	26	1.1 (4.2)	0.7 (3.2)	0.15 (0.30)	0.016 (0.002)
1.25	5	2	16	44	18	1.3 (3.0)	0.2 (0.4)	0.11 (0.20)	0.011 (0.002)
1.00	5	2	14	41	15	1.5 (3.0)	0.2 (0.4)	0.10 (0.20)	0.009 (0.001)
0.625	4	1	9	6	7	1.2 (2.4)	0.1 (0.2)	0.3 (1.0)	0.004 (0.000)
TOTAL	100	100	100	100	100	30.0 (60.0)	8.5 (17.0)	6.0 (12.0)	0.24 (0.48)
									0.04 (0.12)

<sup>a</sup>Reference 61. ESP = electrostatic precipitator.

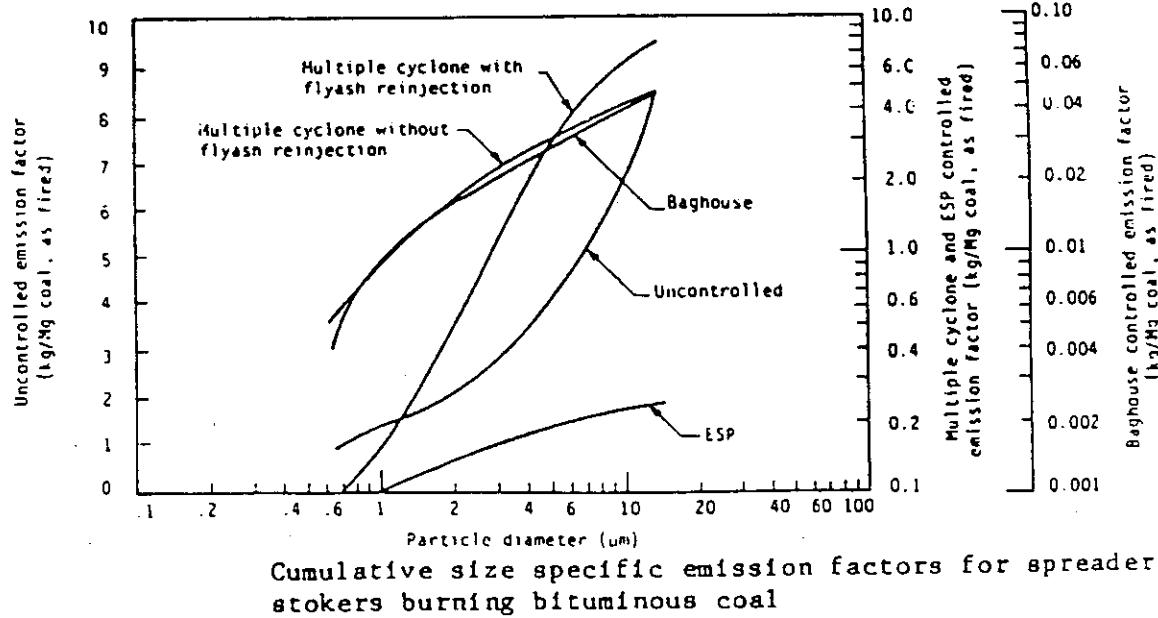
<sup>b</sup>Expressed as aerodynamic equivalent diameter.

<sup>c</sup>With flyash reinjection.

<sup>d</sup>Without flyash reinjection.

<sup>e</sup>Inadequate data.

<sup>f</sup>Estimated control efficiency for ESP, 99.2%; baghouse, 99.8%.



Cumulative size specific emission factors for spreader stokers burning bituminous coal

TABLE 5 (continued): CUMULATIVE PARTICLE SIZE DISTRIBUTION AND SIZE SPECIFIC EMISSION FACTORS FOR DRY BOTTOM BOILERS BURNING PULVERIZED BITUMINOUS COAL<sup>a</sup>

EMISSION FACTOR RATING: C (uncontrolled)  
 D (scrubber and ESP controlled  
 E (multiple cyclone and baghouse)

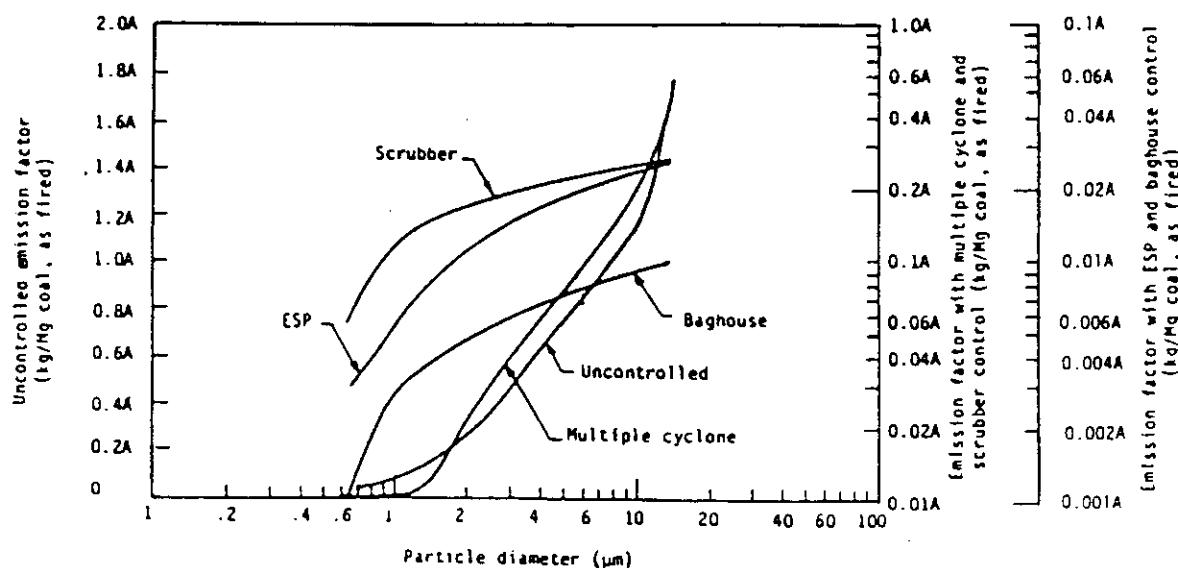
Particle size <sup>b</sup> (μm)	Cumulative mass % < stated size					Cumulative emission factor <sup>c</sup> [kg/Mg (lb/ton) coal, as fired]				
	Uncontrolled	Controlled				Uncontrolled	Controlled <sup>d</sup>			
		Multiple cyclone	Scrubber	ESP	Baghouse		Multiple cyclone	Scrubber	ESP	
15	32	54	81	79	97	1.6A (3.2A)	0.34A (1.08A)	0.24A (0.48A)	0.032A (0.064A)	0.010A (0.02A)
10	23	29	71	67	92	1.15A (2.3A)	0.29A (0.58A)	0.21A (0.42A)	0.027A (0.05A)	0.009A (0.02A)
6	17	14	62	50	77	0.85A (1.7A)	0.14A (0.28A)	0.19A (0.38A)	0.020A (0.04A)	0.006A (0.02A)
2.5	6	3	51	29	53	0.30A (0.6A)	0.03A (0.06A)	0.15A (0.3A)	0.012A (0.02A)	0.005A (0.01A)
1.25	2	1	37	17	31	0.10A (0.2A)	0.01A (0.02A)	0.11A (0.22A)	0.007A (0.01A)	0.003A (0.006A)
1.00	2	1	31	14	25	0.10A (0.2A)	0.01A (0.02A)	0.09A (0.18A)	0.006A (0.01A)	0.003A (0.006A)
0.625	1	1	20	12	14	0.05A (0.10)	0.01A (0.02A)	0.06A (0.12A)	0.005A (0.01A)	0.001A (0.002A)
TOTAL	100	100	100	100	100	3A (10A)	1A (2A)	0.3A (0.6A)	0.04A (0.08A)	0.01A (0.02A)

<sup>a</sup>Reference 61. ESP = electrostatic precipitator.

<sup>b</sup>Expressed as aerodynamic equivalent diameter.

<sup>c</sup>A = coal ash weight %, as fired.

<sup>d</sup>Estimated control efficiency for multiple cyclone, 80%; scrubber, 94%;  
 ESP, 99.2%; baghouse, 99.8%.



Cumulative size specific emission factors for dry bottom boilers burning pulverized bituminous coal.

#### EMISSION FACTORS

TABLE 6. SIZE SPECIFIC EMISSION FACTORS FOR COKE MANUFACTURING

Process	Particulate emission factor rating	Particle size (μm)	Cumulative mass % < stated size	Cumulative mass emission factors	
				kg/Mg	lb/ton
Coal preheating Uncontrolled	D	0.5	44	0.8	1.5
		1.0	48.5	0.8	1.7
		2.0	55	1.0	1.9
		2.5	59.5	1.0	2.1
		5.0	79.5	1.4	2.8
		10.0	97.5	1.7	3.4
		15.0	99.9	1.7	3.5
		100	1.7	3.5	
Controlled with venturi scrubber	D	0.5	78	0.10	0.20
		1.0	80	0.10	0.20
		2.0	83	0.10	0.21
		2.5	84	0.11	0.21
		5.0	88	0.11	0.22
		10.0	94	0.12	0.24
		15.0	96.5	0.12	0.24
		100	0.12	0.25	
Coal charging Sequential or stage	E	0.5	13.5	0.001	0.002
		1.0	25.2	0.002	0.004
		2.0	33.6	0.003	0.005
		2.5	39.1	0.003	0.006
		5.0	45.8	0.004	0.007
		10.0	48.9	0.004	0.008
		15.0	49.0	0.004	0.008
		100	0.008	0.016	
Coke pushing Uncontrolled	D	0.5	3.1	0.02	0.04
		1.0	7.7	0.04	0.09
		2.0	14.8	0.09	0.17
		2.5	16.7	0.10	0.19
		5.0	26.6	0.15	0.30
		10.0	43.3	0.25	0.50
		15.0	50.0	0.29	0.58
		100	0.58	1.15	
Controlled with Venturi scrubber	D	0.5	24	0.02	0.04
		1.0	47	0.04	0.08
		2.0	66.5	0.06	0.12
		2.5	73.5	0.07	0.13
		5.0	75	0.07	0.13
		10.0	87	0.08	0.16
		15.0	92	0.08	0.17
		100	0.09	0.18	

(continued)  
EMISSION FACTORS

TABLE 6 (Continued)

Process	Particulate emission factor rating	Particle size ( $\mu\text{m}$ )	Cumulative mass % $\leq$ stated size	Cumulative mass emission factors	
				kg/Mg	lb/ton
Mobile scrubber car	D	1.0	28.0	0.010	0.020
		2.0	29.5	0.011	0.021
		2.5	30.0	0.011	0.022
		5.0	30.0	0.011	0.022
		10.0	32.0	0.012	0.024
		15.0	35.0	0.013	0.023
		100	0.036	0.072	
Quenching Uncontrolled (dirty water)	D	1.0	13.8	0.36	0.72
		2.5	19.3	0.51	1.01
		5.0	21.4	0.56	1.12
		10.0	22.8	0.60	1.19
		15.0	26.4	0.69	1.38
		100	2.62	5.24	
Uncontrolled (clean water)	B	1.0	4.0	0.02	0.05
		2.5	11.1	0.06	0.13
		5.0	19.1	0.11	0.22
		10.0	30.1	0.17	0.34
		15.0	37.4	0.21	0.42
		100	0.57	1.13	
With baffles (dirty water)	D	1.0	8.5	0.06	0.11
		2.5	20.4	0.13	0.27
		5.0	24.8	0.16	0.32
		10.0	32.3	0.21	0.42
		15.0	49.8	0.32	0.65
		100	0.65	1.30	
With baffles (clean water)	D	1.0	1.2	0.003	0.006
		2.5	6.0	0.02	0.03
		5.0	7.0	0.02	0.04
		10.0	9.8	0.03	0.05
		15.0	15.1	0.04	0.08
		100	0.27	0.54	
Combustion stack Uncontrolled	D	1.0	77.4	0.18	0.36
		2.0	85.7	0.20	0.40
		2.5	93.5	0.22	0.44
		5.0	95.8	0.22	0.45
		10.0	95.9	0.22	0.45
		15.0	96	0.22	0.45
		100	0.23	0.47	

In many instances these factors are of minor influence to site selection particularly when viewed from the perspective of the 24-hour averaging period that defines most operational PM<sub>10</sub> monitoring. More often, however, these influences are severe enough to warrant attention, particularly in source-oriented applications. There are many circumstances where an area may experience aerodynamic diversion problems under moderate to strong synoptic influences while exhibiting local circulations when synoptic conditions are weak. Because of this, discussion of these two factors is structured around the physical aspects of the monitoring scene that should alert the monitoring designer to the situation. Four primary areas for discussion have been identified: topographic influences, coastal settings, small-scale obstacles, and urban effects.

These factors are expressed in varying intensity from area to area. A detailed discussion of resulting patterns is clearly beyond the intended scope of this document. Therefore, each topical area will be treated in summary fashion, and the description will rely heavily upon illustrations.

#### Topographic Influences--

Topographic elements become a factor when their influences extend into the neighborhood scale (horizontal size order of kilometers). Because the ratio of downstream aerodynamic effect to obstacle height is on the size order of 10 to 1, obstacles on the order of 100 m will influence horizontal sizes of the order of 1 km. The central problem that terrain introduces is the added detail impressed upon the advection/dispersion field. That is, a simple pattern that may be replicated consistently throughout a scene of level terrain becomes an inconstant three-dimensional perturbation in the presence of substantial terrain relief. The principal types of flow distortion that occur include separation flow on the downwind side of ridges when the flow is perpendicular to the ridge, channeling of air flow by valleys, and local circulations caused by differential heating of adjacent terrain slopes.

#### Coastal Settings--

In coastal settings, during periods of light synoptic winds accompanied by a sufficiently strong thermal contrast between water temperatures and land temperatures, a land/sea breeze circulation (or conversely, land/lake breeze) will control air motions in the vicinity of the shoreline.

Figure 8 displays the characteristic circulation patterns associated with a lake (or sea) breeze (8a) and a land breeze (8b). This circulation system is not static. As shown in Figure 9, the convergence zone migrates inland as the land surface heats up. The intensity of the sea breeze may increase through midafternoon, but dies out after sunset as the land surface rapidly cools. At night, the land breeze sets up, but is generally less vigorous because thermal contrasts are smaller.

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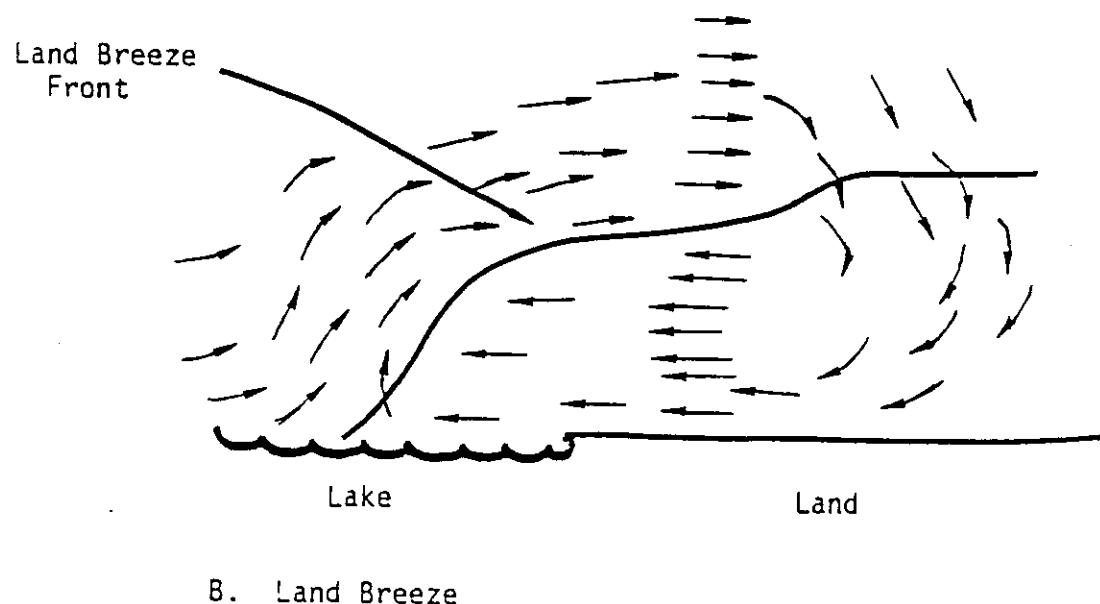
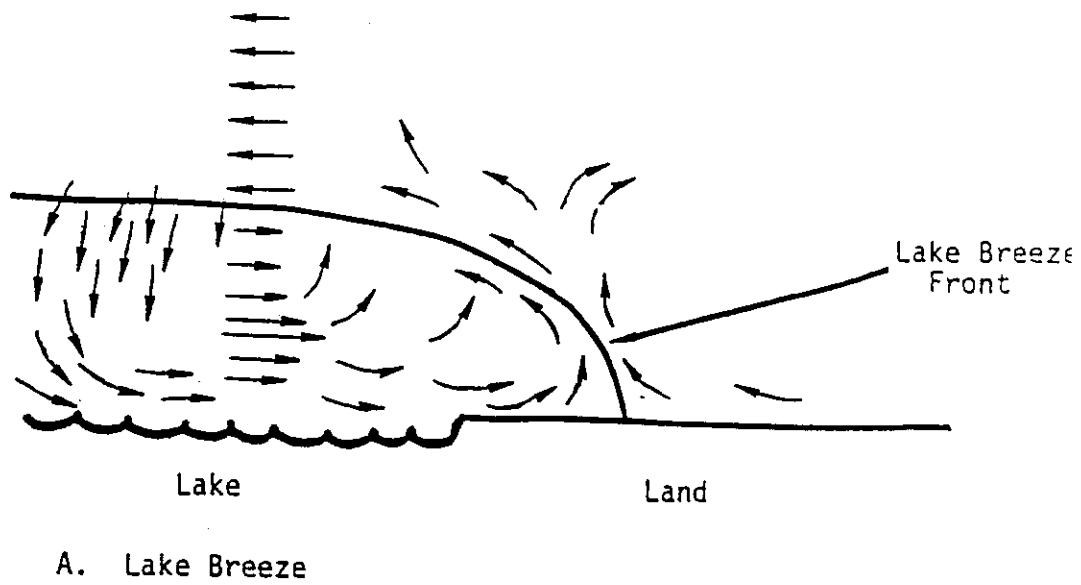


Figure 8. Characteristics of lake coast air flow.

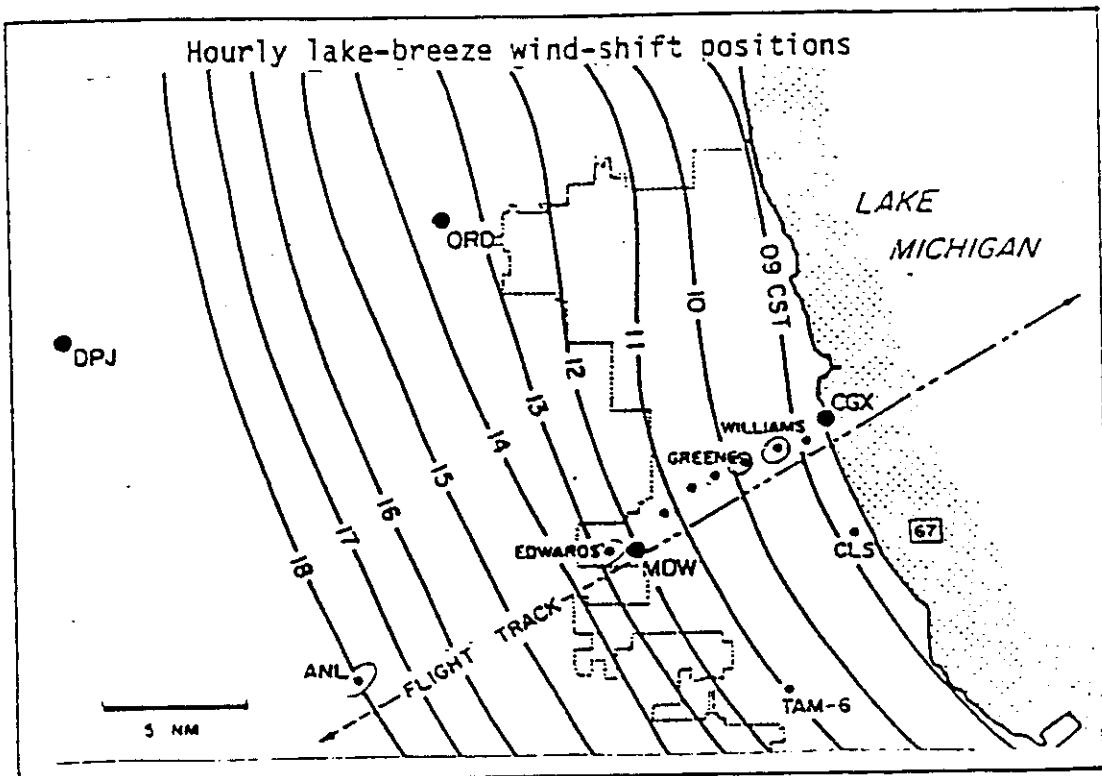


Figure 9. Hourly positions of lake breeze front of August 13, 1967, with the ground track of the NACR Queen air plotted. Hygrothermograph traces at several distances from the shoreline are included. Surface water temperature is 67° F. One full wind barb equals 5 knots. From Lyons and Olsson 1972.

The primary impact of this system is to recompose a coastal monitoring scene into at least two siting domains: one area subject to the land/sea breeze effects, another outside of this influence. The size and extent of the land/sea breeze-affected subarea can be assessed in a number of ways. An obvious factor of contrast is the horizontal distribution of wind directions on appropriate days; however, few areas have sufficiently detailed meteorological networks to define the horizontal extent of the area and the change in size of the affected area with time. A more reasonable approach is to use air temperature and relative humidity patterns to characterize this effect. Figure 9 displays distinctive signatures in hygrothermograph recordings and suggests a method of analysis that may be helpful.

### Small Scale Obstacles--

Wind deflection around and over obstacles is a concern in selecting specific sites in an urban area, because the effects occur on the microscale. As shown in Figure 10, air does not simply slip past an isolated structure. There are three distinguishable zones of air around a building:

1. Displacement zone--where streamlines are deflected upwind and outward, remaining so for some distance
2. Wake zone--where streamlines gradually recover original configuration
3. Cavity zone--return flow in the immediate vicinity of the downwind side.

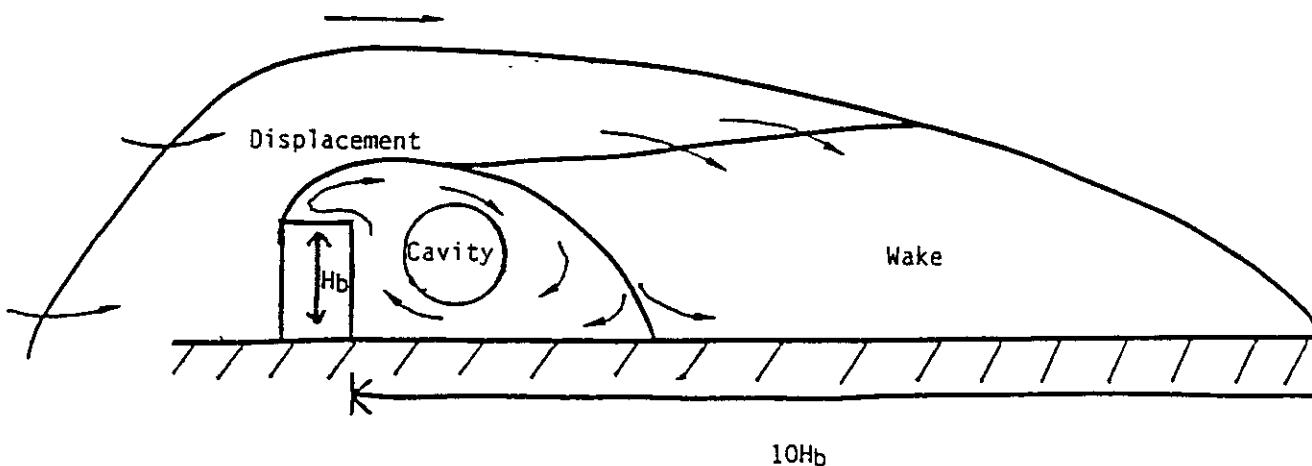


Figure 10. Flow zones around a building

In terms of site selection, this effect is of obvious importance if an intervening obstacle contains a strong enough source to generate a ground-level impact that would be assigned to a source further upstream--particularly if monitoring were to unwittingly take place in the cavity zone. This effect is further complicated when many such obstacles are placed together, as shown in Figure 11.

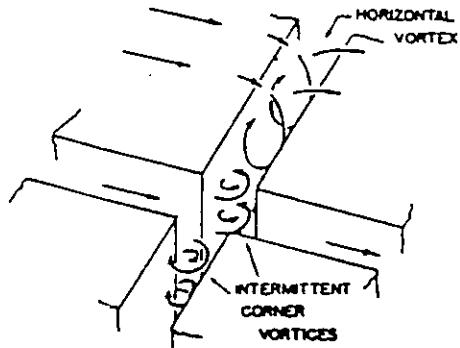


Figure 11. Flow characteristics among multiple buildings.

#### Urban Effects--

In addition to the effects of individual buildings, a city induces large-scale modifications to the local wind field. These modifications have a bearing on site selection, due to the heat island circulation.

When a heat island circulation exists, there is a convergence zone over the center of the city and a return flow into outlying areas, as illustrated in Figure 12. This circulation pattern is most pronounced at night when differential radiative cooling rates favor higher temperatures in the urban center. The circulation pattern is generally weaker during the day when urban/rural thermal contrasts are not as strong. Table 7 summarizes the general magnitude of key heat island circulation elements.

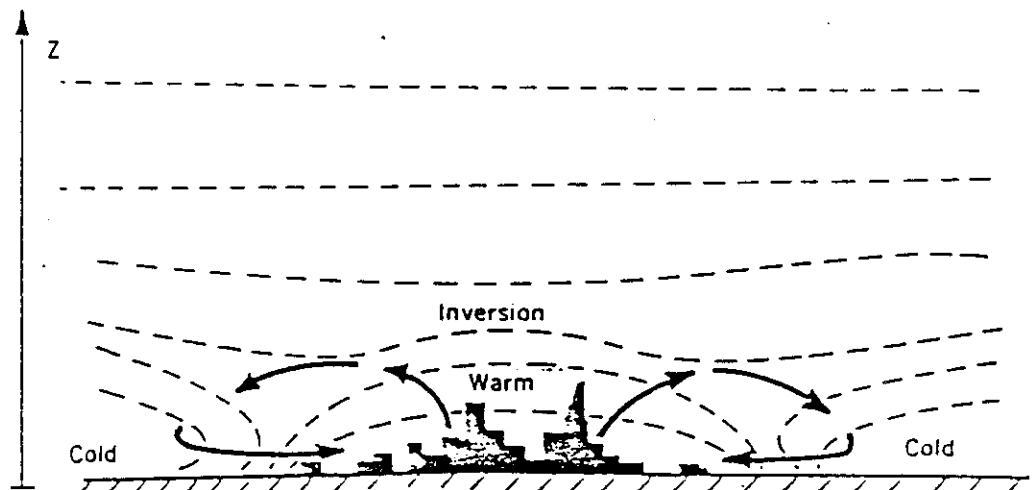


Figure 12. Idealized urban heat island air flow (After Landsberg 1975).

TABLE 7. ESTIMATES OF THE ST. LOUIS, MISSOURI, HEAT ISLAND CIRCULATION

Element	General magnitude
Urban/rural temperature difference	$\geq 2^{\circ}\text{C}$
Gradient wind (900 mb)	$\geq 5 \text{ m/sec}$
Average surface wind	2 m/sec
Average vertical velocity	0.3 m/sec
Diameter of surface inflow	30 km
Diameter of updraft	7 km
Depth of circulation	1 km

Source: Landsberg.

Under sufficiently strong winds, the heat island circulation is overwhelmed. Oke and Hannel (1970) have developed a simple relationship between the threshold wind speed to prohibit the circulation and relative city size. Oke and Hannel's empirical formulation is as follows:

$$U_{lim} = 3.4 \text{ LogP}-11.6$$

where P is the population number. Thus, a large urban area whose population is counted in the millions can exhibit a heat island circulation even if regional winds are quite strong. Although this relationship showed a high correlation (94 percent variance explained) for the cities studied, it should not be treated as an absolute measure. Each urban setting will have its own idiosyncrasies due to local terrain, presence of water bodies, or other factors.

#### Climatology

Regional dispersion climatology encompasses those atmospheric parameters of regional scale influence that affect the distribution of ambient concentration. The parameters of primary concern are advection, dispersion, and vertical mixing. With the exception of advection (i.e., surface winds), the instrumentation to acquire direct measures of these parameters are generally not found in most settings. Even when relevant measurements are available, the important fine structure needed to characterize significant air pollution

1975).

transport is generally not observed (e.g., Hewson 1976; Holzworth 1974; and McCormick and Holzworth 1976). Nevertheless, it is important to consider what regular data are available to estimate advection, dispersion, and vertical mixing. Additional parameters needed for air quality simulations are also considered.

#### Advection--

For most monitoring objectives, advection is adequately defined by the near-surface wind (speed and direction) measured at (or adjusted to) a reference height of 10 meters above the ground. Useful observations may consist of short-term averages taken hourly or every 3 hours, as well as true algebraic or vectorial averages over these time intervals. Nearly continuous recordings are sometimes available.

Directional air flow is an intuitively appealing siting tool. One of the most useful summary depictions is the wind rose that expresses advection in terms of relative frequency of occurrence by direction, usually with a breakdown of wind speed by classes within each directional interval. By convention, a wind direction denotes the sector from which wind is blowing. Wind roses may be compared on an 8-point basis, a 16-point basis, or a 36-point basis.

The most common summary wind roses are compared for annual, seasonal, or monthly distributions (see Figure 13). Under some circumstances, wind roses are devised to study winds under critical conditions. For example, STAR<sup>1</sup> summaries offer a joint frequency distribution of winds and atmospheric stability. These are available from the National Climatic Center and may be compared for various time periods. Additional categories of wind roses include winds under important pollutant index levels, distribution of persistent 24-hour winds, and distributions within key parts of the day (i.e., morning versus afternoon).

#### Dispersion--

Dispersion is the summary effect of atmospheric turbulence in actively diluting source material. Direct measurements of the three-dimensional wind fluctuations that manifest turbulence are rarely made. Instead, various methods of characterizing turbulence based on theoretical and empirical relationships are employed. The most common system is based upon associations among wind speed, solar insolation, and cloud cover, as shown in Table 8. Many operational models accept this type of data directly, and manual techniques have evolved to treat these as well (see Turner 1970).

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<sup>1</sup> Stability ARray, a broad-based algorithm for determining stability in the lower atmosphere using estimates based on winds and cloudiness. See Doty, Wallace, and Holzworth 1976.

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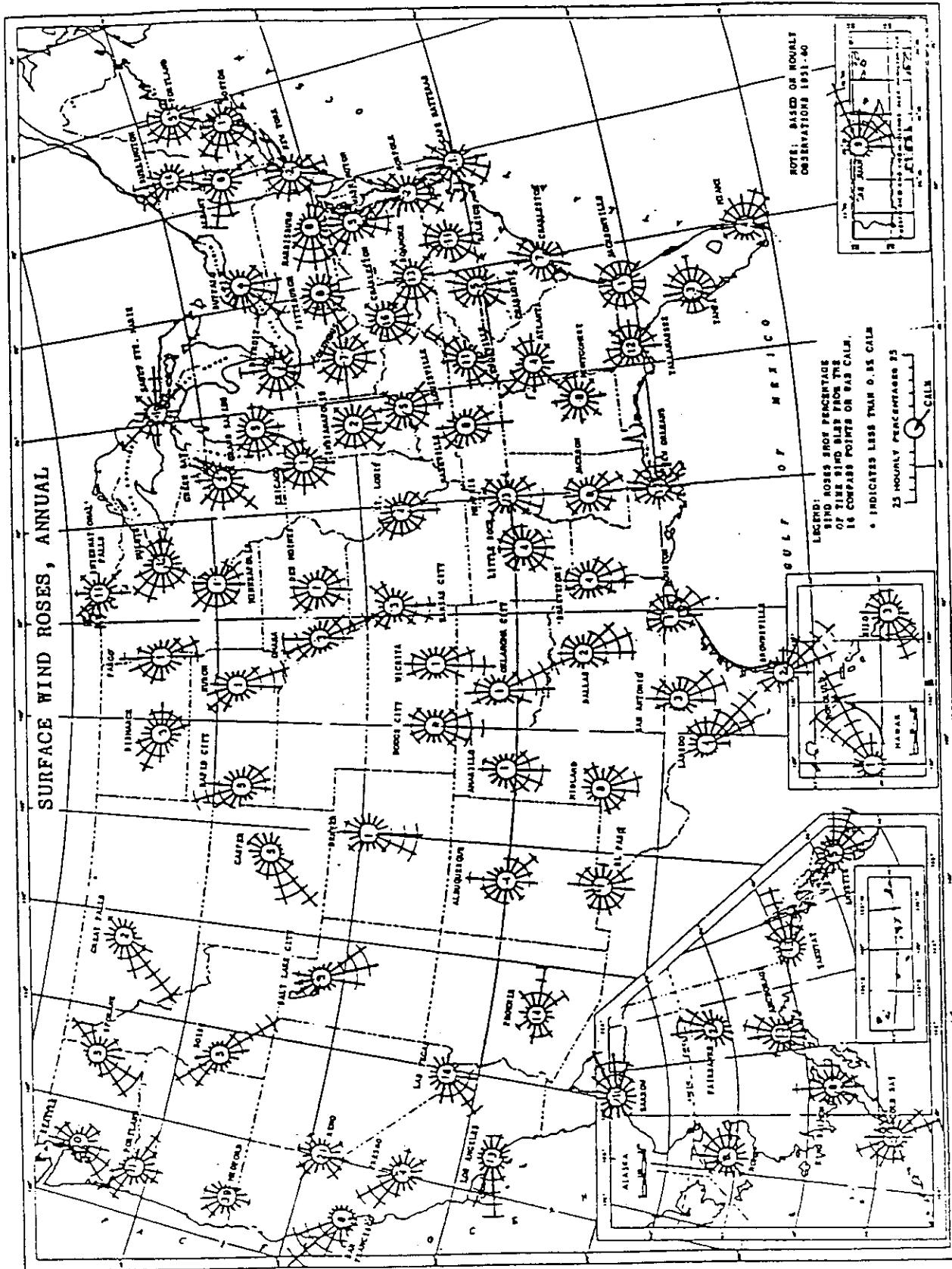


Figure 13. Annual wind roses for U. S. locations.

TABLE 8. DISPERSION CLASSIFICATIONS (PASQUILL 1961)

Surface wind speed at 10 m (m sec <sup>-1</sup> )	Insolation			Night	
	Strong	Moderate	Slight	Thinly overcast or >4/8 low cloud	<3/8 clo
2	A	A-B	B	-	-
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	C	D	D	D

## Mixing Height--

Mixing height defines the vertical extent of mixing. Ground-based and low-level inversions are the principal limiting factors. Mixing height is determined from a thermodynamic analysis of vertical temperature soundings. These soundings are routinely performed at 0000 GMT and 1200 GMT each day at a number of stations. Contact National Climactic Center (see Appendix A) for a list. Additionally, climatological summaries are also available (see Holzworth 1972).

## Other Parameters--

Additional parameters that may be useful are listed below. Routine data sources are summarized in Appendix B.

- Solar radiation--for estimates of formation rates of secondary aerosols
- Visibility--as a proxy for regional scale impacts
- Precipitation--to relate to scavenging processes
- Air temperature--to be applied to plume rise estimates, or as a fine adjustment to residential space heating demand as a proxy for some combustion sources.

## TAXONOMY OF REPRESENTATIVE SITES

By classifying monitoring objectives and monitoring sites, it is possible to categorize all monitoring requirements into discrete groupings. Siting methods that are appropriate to each group or to several groups can be more easily identified. Furthermore, some groupings may be of little interest and need not receive further attention.

In the preceding section, spatial scales of areas were defined within which air quality levels are reasonably homogeneous for typical organizations of human structures and activities that characterize each scale. These definitions were very general. The physical characteristics that primarily contribute to variations in air quality include sources of emissions, types of terrain, and types of meteorological influences. Each of these characteristics and the nature of the variations that affect air quality levels have been previously discussed.

For the purpose of classifying representative siting situations with respect to PM<sub>10</sub>, the following three categories of sources of emissions are of interest:

- Background or general region
- General urban or industrial area
  - Homogeneous
  - Complex
- Major source within an urban area
- Isolated source.

With respect to terrain influences the following categories of topographical features are of interest:

- Plains
- Coast
- Ridge and valley
- Irregular terrain
  - Extremely rough
  - Moderately rough
- Urban.

Although mixtures of the above terrain influences are possible, it is unreal to attempt to characterize such complex influences within the scope of present modeling and analysis methods. For monitoring planning purposes, it may be best to incorporate the single most important influence into the analysis.

With respect to meteorological influences on air quality levels, there are two important categories of features that have been frequently cited as being important in creating poor air quality levels. These categories are (1) stagnation situations with limited vertical mixing and little advection for prolonged periods and (2) persistent winds in which pollution from a source is consistently transported to the same location for a prolonged period. The following categories of meteorological influences are of interest:

- Frequent air stagnation conditions
- Frequent persistent winds
- Normally variable meteorological conditions.

For PM<sub>10</sub> air quality levels, there are two averaging times of interest: 24-hour and 1-year. The pattern of effects associated with these two averaging periods may differ, in that shorter term effects usually occur closer to the source than do longer term effects.

Based on the above factors, there are 120 possible representative siting situations consisting of all the following combinations:

4 classes of sources  
5 classes of terrain  
3 classes of meteorology  
2 classes of averaging times.

However, for the purpose of identifying methodologies to use in determining siting needs, the same approach is applicable to many of the combinations. One need not use different approaches to treat different averaging times. Also, the meteorological influences are associated with the influences due to terrain and need not be treated as independent factors. Eliminating time and meteorology reduces the number of combinations to 20. With regard to air quality levels associated with background or distance sources that affect a general region as a whole, variations in terrain are not important. The concentrations of PM<sub>10</sub> will be homogeneous over large areas and not affected by terrain variations. Siting methodologies are limited to simple situations in which a single dominant terrain is identified. At the present time, practical methodologies have not been developed for treating multiple sources in other than simple terrain situations. Practical models for treating coastal, ridge/valley, and irregular terrain for general urban sources or a major source in conjunction with general urban sources are not presented here. These two source categories are not applicable to the terrain type, leaving only the urban terrain situation. This leaves the terrain variation being treated only with respect to isolated sources.

There are only two terrain situations applicable to isolated sources since the isolated source with urban terrain is the same case as a major source within an urban area. This results in four categories of sites. Because of the range of alternative configurations of sources in urban areas, two categories are included, which may be designated complex and uniform.

As a result of these considerations, we have defined the following six representative siting situations for which specific guidelines are presented in the next section:

- o Regional scale (1)
- o General urban area
  - Complex (2)
  - Uniform (3)
- o Major source within urban area (4)
- o Isolated source
  - Plains (5)
  - Irregular terrain (6)

APPENDIX A  
METEOROLOGICAL DATA TABULATIONS FOR CDM PROGRAM

Cities for which Stability Array (STAR) data tabulations are available are listed alphabetically by date and by city within a state. This list was compiled by Changery, Hodge, and Ramsdell (1977). Additional tabulations may be available since this compilation, and others may be ordered. For assistance on orders contact:

Director  
National Climatic Center  
Federal Building  
Asheville, North Carolina 28801

#### A-1. EXPLANATION OF ENTRIES

CITY is the city or town name for the location at which the original observations were taken. It may also be the name of a military installation.

NAME-TYPE is usually the airport or field name and/or service which operated the station. If these had changed during the period summarized, the name and/or service valid for the longest portion of the summary is used. A few stations may have no identifying information.

Under NAME, commonly used abbreviations are:

APT	-	Airport
ATL	-	Air Terminal
BD	-	Building
CAP	-	County Airport
CO	-	County
FLD	-	Field
GEN	-	General
GTR	-	Greater
INL	-	International
MAP	-	Municipal Airport
MEM	-	Memorial
METRO	-	Metropolitan
MN	-	Municipal
RGL	-	Regional
TERM	-	Terminal

Under TYPE, commonly used abbreviations are:

AAB	-	Army Air Base
AAF	-	Army Air Field
AAFB	-	Auxiliary Air Force Base
AEPG	-	Army Energy Proving Ground
AF	-	Air Force
AFB	-	Air Force Base
AFS	-	Air Force Station
ANG8	-	Air National Guard Base
ASC	-	Army Signal Corp
CAA	-	Civil Aeronautics Administration
FAA	-	Federal Aviation Administration
FSS	-	Flight Service Station
LAWR	-	Limited Airways Weather Reporting (Station)
MCAF	-	Marine Corps Air Facility
MCAS	-	Marine Corps Air Station
NAAF	-	Naval Auxiliary Air Facility
NAAS	-	Naval Auxiliary Air Station
NAF	-	Naval Air Facility
NAS	-	Naval Air Station
NAU	-	Naval Air Unit
NF	-	Naval Facility
NS	-	Naval Station
PG	-	Proving Ground
SAWR	-	Supplementary Airways Weather Reporting (Station)
WBAS	-	Weather Bureau Airport Station
WBO	-	Weather Bureau Office

ST is a two-letter code identifying each of the fifty states.

WBAN # refers to the five-digit number identifying stations operated by United States Weather Services (civilian and military) currently or in the past. A few stations have had no number assigned.

WMO # refers to the five-digit block and station numbers assigned to U. S. stations as authorized by the World Meteorological Organization. Many stations with a WBAN # will have no corresponding WMO number.

LAT, LONG are the latitude and longitude of the station in degrees and minutes. If the station changed coordinates during the period summarized, the location reflects the site with the longest record.

ELEV is the elevation (above sea level) of the station in meters. Reported station elevation was used if the barometric height above sea level was not available. If an elevation change occurred during the period summarized, the elevation reflects the station height for the longest period of record.

PERIOD OF RECORD is the first and last month-year of the summarized period. As an example, 01 38 - 12 44 is read as January 1938 through December 1944.

SUMMARY TYPE identifies each summary according to its format. Each format is similar to one of the 16 types presented in detail beginning on page I-13.

SUMM FREQ is the summary frequency or the time period in which the summarized data are presented. Abbreviations used are:

M - Monthly. Data for each calendar month combined and presented on a monthly basis.

S - Seasonal. Data for the months December through February of the period of record are combined into a winter season, summarized and presented on a seasonal basis. The months March-May, June-August, and September-November are similarly summarized.

A - Annual. All data for the period summarized together.

MA - Monthly and Annual.

SA - Seasonal and Annual.

MS - Monthly and Seasonal.

MSA - Monthly, Seasonal, and Annual.

IYM - Individual Year-Month. Data are presented for individual months of record.

SP - Special Period. The special period presented is described further in the given summary's Tab #/Remarks column.

TAB #/REMARKS column contains additional identifying or explanatory information. Many of the summaries produced by the Climatic Center and Air Weather Service for a specific project are identified by a tabulation number. A "T" followed by a 4 or 5 digit number identifies a summary produced by the NCC. Similarly, a "TCL" with a number indicates an AWS summary. Not all summaries can be so identified. This number is provided as an aid in requesting a specific tabulation.

Numbers following or in place of a tabulation number refer to remarks listed beginning on page I-9. These remarks are provided if additional information describing a summary is necessary. Examples are summaries with data for hourly or 3-hour periods, specified hours only, combined stations, etc.

## A-2. REMARKS

This is a list of descriptive remarks coded by number in the Tab #/Remarks column of the index. Numbers missing were not used.

1. Broken period
2. 3-hourly groups
3. Day-night
4. 0600-1800 LST only
5. 10-12 observations per day, all daylight hours
6. By hours 00, 03, 06, 09, 12, 15, 18, 21 LST
7. See microfilm for broken periods and format
8. Includes flying weather conditions
9. Part "C" only
10. Hours 0600-1200 LST only
11. May-November only
12. Broken period - pre-11/45 data from Point Hope (Stn #25601)
13. Broken period by hourly groups
14. Less 12/59
15. Pre-1939 data from Tin City (Stn #26634)
16. Less 12/70
17. 0500-1600 LST only
18. 2-13 observations daily .
19. 0700-1900 LST only
20. Combined data for Douglas AAF (Stn #23001) for 11/42-11/45 and Douglas Apt (Stn #93026) for 11/48-12/54
21. Part "A" only by hourly groups - combined data for Kingman CAA (Stn #93167) for 01/34-12/41 and Kingman AAF (Stn #23108) for 03/43-06/45
22. For hours 0800, 1400, 1700 LST only
23. Direction and speed by visibility, relative humidity  $\geq$  90% and/or precipitation, and relative humidity  $\geq$  90% and no precipitation - August, October, and December only
24. Part "A" only
25. By 2-hourly groups
26. Daylight hours only
27. September-December only
28. By hourly groups
29. For 0900-1600 and 1700-0800 LST
30. Period 01/37-03/38 for Indio (Stn #03105)
31. Precipitation-wind tabulation for April-October
32. By day and night hours on microfilm
33. Periods: July 15-31, August 1-15 for 1000 and 1400 LST
34. No data for 27 months
35. See Edwards AFB
36. Some data from Paso Robles (Stn #23231)
37. All observations by various stability classes
38. See Moffett Field
39. Also contains a contact wind rose
40. Eight directions and calm
41. Includes a percentage graph

- 42. 1200 LST observations only
- 43. Some missing data
- 44. Contains all weather, precipitation, and visibility  $\leq$  6 miles  
wind tabulations for day and night hours
- 45. Also called 94A
- 46. See Farallon Island SE
- 47A. 0100-0400 LST
- 47B. 0700-1000 LST
- 47C. 1300-1600 LST
- 47D. 1900-2200 LST
- 47E. 0600-2200 LST
- 47F. 0700 LST
- 47G. 1600 LST
- 47H. 0600-0900 LST
- 47I. 1600-1800 LST
- 47J. 0700-0900 LST
- 47K. 1900-0600 LST
- 47L. 1000-1500 LST
- 47M. 1200-2000 LST
- 47N. 0800-2100 LST
- 47P. 1100-1300 LST
- 48. Also contains bimonthly summaries
- 49. Located in city file
- 50. Three speed groups
- 51. June, July, August - daylight hours only
- 52. Special tables
- 53. Pre-1944 data from Bolling AAF (Stn #13710)
- 54. Also known as Chantilly, VA, FAA (pre-Dulles)
- 55. See Andrews AFB, MD
- 56. Data for 01/74 from Herndon Apt (Stn #12841)
- 57. See also Cape Kennedy AFB
- 58. Tower data - 8 levels (3-150 m)
- 59. June-August only
- 60. Data for 09/42-09/45 from Carlsbad AAF (Stn #23006)
- 61. Data after 07/53 from Key West NAS (Stn #12850)
- 62. Data thru 1945 from Marianna AAF (Stn #13851)
- 63. Contains 14 months of data from Morrison Field (Stn #12865)
- 64. Contains graphical wind rose
- 65. Tabulated by temperature and relative humidity intervals
- 66. Seasonal by day and night hours
- 67. Closed and instrument weather conditions only
- 68. Less 01/49
- 69. 24 observations daily
- 70. 8 observations daily
- 71. 1 of 3 parts
- 72. Tabulation by day and night hours for May 1 - September 30 and  
October 1 - April 30
- 73. Tabulated for December-March and April-November
- 74. Data prior to 10/42 and after 10/45 from Sioux City Apt (Stn #14943)

75. For day - clear and cloudy and night - clear and cloudy conditions  
76. Also contains a ceiling-visibility tabulation  
77. 0700-1900 LST only  
78. All weather and 2 relative humidity classes  
79. Summer season only - 1957 missing  
80. May, August-November only  
81. Includes separate wind rose for WSO  
82. Four speed categories  
83. Monthly tabulation for 0400 and 1400 LST, seasonal tabulation for all observations  
84. Some data from Presque Isle AFB (Stn #14604)  
85. Four observations per day  
86. Semi-monthly periods  
87. 1935 data from Boston WBAS (Stn #14739)  
88. VFR, IFR, closed conditions  
89. Pre-03/1952 data from Paso Robles (Stn #23231)  
90. August 1-15 only for hours 1000 and 1400 LST  
91. Partial SMOS  
92. June, July only for hours 2200L - 0200L  
93. April thru December only  
94. Less April 1958 and 1960  
95. January, April, July, and October only  
96. Winter season only  
97. Part "C" and "E" only  
98. 36 compass points  
99. Less October-December 1945 for a 2-hour period after sunrise  
100. November 1951 substituted for November 1955  
102. For hour groups 07-09, 10-15, 16-18, and 19-06 LST and all hours combined  
103. For hours 0100, 0700, 1300, and 1900 LST (individual and all hours combined)  
104. Day and night hours, clear and cloudy conditions  
106. Pre-02/33 data from Albuquerque WBO (Stn #23073)  
108. Precipitation wind rose tabulation  
109. All observations by 6 hourly groups  
110. For ceiling less than 600 feet and/or visibility less than 1-1/2 miles - also an annual hourly summary  
111. Also summarized by month-hour for hours 0200 and 1400 LST  
112. Summarized by days 1-15 and 16 to end of month for day and night hours  
115A. 1300 LST  
115B. 0400 LST  
115C. 1000 LST  
115D. 1600 LST  
115E. 2200 LST  
115F. 0700 LST  
115G. 0100 LST  
115H. 1900 LST  
117. See Covington, Kentucky  
118. Pre-04/32 data from Oklahoma City WBO (Stn #93954)  
119. May to October only

120. Monthly for 1961-63, individual months 1-4/64  
121. Also contains day and night summaries  
124. Summary titled Scranton  
125. See Wilkes-Barre  
126. December-February for 0730 and 1930 LST only  
128. Pre-12/44 data from Galveston AAF (Stn #12905)  
129. Data for 10/62-12/63 for Greenville-Spartanburg Apt (Stn #03870)  
132. February-April and June-September only  
133. Pre-03/43 data from English Field (Stn #23047)  
134. Post-10/66 data from Fort Wolters  
135. Less 6/68  
136. For hours 00-23 and 07-22 LST  
140. Also contains annual ceiling/visibility tabulation  
141. Less 0000 and 0300 LST  
142. See Killeen  
143. See Dugway PG  
144. Data for 1943-49 for Wendover AFB (Stn #24111)  
145. 0400-1800 LST  
146. See Washington, DC - Dulles International Apt WBAS  
147. See Washington, DC - National Apt WBAS  
149. 0700-1200 LST  
150. Tower data, year-month-level, month-level, and month-level-hour  
151. Pre-11/41 data from Paine Field CAA (Stn #24222)  
152. 10 observations per day - closed on weekends  
153. 10 observations per day - wind speed estimated  
155. By 5°F temperature intervals - with and without thunderstorms  
157. One speed group - greater than 14 knots  
158. Speed classes in Beaufort Force - mean speed by direction in mph  
159. Hourly groups for 0600-1600 LST  
160. Post-05/55 data from Forest Sherman (Stn #03855)  
161. By speed classes and 5°F temperature classes  
162. For all hours combined and for hours 0030 and 1230 individually

CITY	NAME - TYPE	ST	W	E	LAT	LONG	ELEV	PERIOD	SP	SUMM	SUMM
								RECD300	TYPE	SPED	SPED
AMERISTAR	CAL-HOUR CS ART CAR	AL	13671		33 35N	885 51W	2183	01 45 - 12 54	STAR	SA	T12772
BIRMINGHAM	MUNICIPAL ART WARS	AL	13876	72229	33 34N	886 45W	2182	01 50 - 12 54	STAR	TR	T12741
BIRMINGHAM	MUNICIPAL ART WARS	AL	13876	72228	33 34N	886 45W	2182	01 51 - 12 51	STAR	SA	T12818
FORT RUCKER	CATFISH AAF	AL	13876	72228	33 34N	886 45W	2182	01 52 - 12 52	STAR	SA	T3C979
HUNTSVILLE	HUNTSVL-MOISON CAR WARS	AL	03850		31 18N	885 43W	2081	01 45 - 12 58	STAR	SA	T12781
HUNTSVILLE	HUNTSVL-MOISON CAR WARS	AL	03856	72223	34 38N	886 46W	2196	01 50 - 12 54	STAR	SA	T14716
MOBILE	SATES FLO WARS	AL	13884	72223	30 41N	886 15W	2088	01 44 - 12 70	STAR	SA	T3C970
MOBILE	SATES FLO WARS	AL	13884	72223	30 41N	886 15W	2088	01 50 - 12 74	STAR	SA	T12825
MOBILE	SATES FLO WARS	AL	13884	72223	30 41N	886 15W	2088	01 50 - 12 70	STAR	SA	T12825
MONTGOMERY	JANNELLY FLO WARS	AL	13885	72226	32 18N	886 24W	2081	01 50 - 12 72	STAR	A	T3C970
MONTGOMERY	JANNELLY FLO WARS	AL	13885	72226	32 18N	886 24W	2081	01 52 - 12 72	STAR	SA	T12867
SELMA	CRAIG AFB	AL	12850		32 21N	886 10W	0083	01 54 - 12 58	STAR	SA	T3C970
TUSCALOOSA	VAR DE GRAFF ART CAR	AL	03806		33 14N	887 37W	0057	01 46 - 12 54	STAR	A	T12867
ANCHORAGE	ELKHORNDR AFB	AK	28401	70272	61 15N	146 49W	0054	01 51 - 12 70	STAR	TR	T15332.3
ANCHORAGE	INTERNATIONAL ART WARS	AK	28401	70273	61 15N	146 49W	0054	01 55 - 12 68	STAR	TR	T13853
BIG DELTA	FAR	AK	28415	70267	64 00N	146 44W	0368	01 60 - 12 64	STAR	SA	T14063
BIG DELTA	FAR	AK	28415	70267	64 00N	146 44W	0368	01 67 - 12 71	STAR	SA	T14063
CODORVA	MLE 13 ART FAR	AK	28410	70286	50 30N	146 30W	0213	01 58 - 12 62	STAR	SA	T30320
FAIRBANKS	ESCILOM AFB	AK	28407	70265	64 00N	147 04W	0186	01 51 - 12 70	STAR	SA	T14703
FAIRBANKS	INTERNATIONAL ART WARS	AK	28411	70261	64 00N	147 02W	0184	01 51 - 12 70	STAR	SA	T14703
GULKAHA	INTERMEDIATE FIELD	AK	28425	70271	62 38N	145 27W	0461	01 67 - 12 71	STAR	SA	T14063
KENAI	MUNICIPAL ART CAR	AK	28523	70250	60 34N	151 19W	0207	01 48 - 12 56	STAR	TR	T15332.3
KENAI	MUNICIPAL ART FAR	AK	28523	70250	60 34N	151 19W	0203	01 46 - 12 70	STAR	SA	T13873
MIDDLETON ISL	FAR	AK	29403	70343	56 28N	146 18W	0013	01 58 - 12 62	STAR	SA	T30320
DOUGLAS	8138CE-OGLS INL ART WARS	AZ	93026		31 27N	108 36W	1252	01 50 - 12 54	STAR	SA	T50672.3
DOUGLAS	8138CE-OGLS INL ART CAR	AZ	93026		31 27N	108 36W	1252	01 50 - 12 54	STAR	SA	T13285
PHOENIX	SKY HARBOR FAR WARS	AZ	23183	72270	33 26N	112 01W	0336	01 55 - 12 64	STAR	TR	T14334
PHOENIX	SKY HARBOR FAR WARS	AZ	23183	72270	33 28N	112 01W	0336	01 67 - 12 71	STAR	TR	T12791
PHOENIX	SKY HARBOR FAR WARS	AZ	23183	72270	33 26N	112 01W	0336	01 58 - 12 73	STAR	SA	T30564.22
PHOENIX	SKY HARBOR FAR WARS	AZ	23183	72270	33 26N	112 01W	0336	01 73 - 12 75	STAR	SA	T32278.3
PHOENIX	SKY HARBOR FAR WARS	AZ	23183	72270	33 26N	112 01W	0336	01 73 - 12 75	STAR	SA	T32262.3
PHOENIX	SKY HARBOR FAR WARS	AZ	23183	72270	33 26N	112 01W	0336	01 73 - 12 75	STAR	SA	T32279.3
PRESERVE	MUNICIPAL ART WARS	AZ	23184	72272	33 26N	112 01W	0338	01 79 - 12 75	STAR	TR	T32282.3
TUCSON	MUNICIPAL ART WARS	AZ	23180	72274	32 08N	110 57W	0770	01 55 - 12 64	STAR	TR	T12772
TUCSON	MUNICIPAL ART WARS	AZ	23180	72274	32 08N	110 57W	0770	01 56 - 12 63	STAR	TR	T14334
TUCSON	INL ART WARS	AZ	23180	72274	32 07N	110 56W	0769	01 47 - 12 71	STAR	TR	T13111
TUCSON	INL ART WARS	AZ	23180	72274	32 07N	110 56W	0769	01 57 - 12 71	STAR	TR	T14366
YUMA	INTERNATIONAL ART WARS	AZ	23185	72280	32 40N	114 38W	0062	01 57 - 12 71	STAR	SA	T14316
EL DORADO	GOODWIN FIELD CAR	AR	93062		33 13N	082 48W	0082	01 50 - 12 54	STAR	SA	T30055
FORT SMITH	MUNICIPAL ART WARS	AR	13864	72344	35 20N	084 23W	0141	01 55 - 12 74	STAR	TR	T1627.3
FORT SMITH	MUNICIPAL ART WARS	AR	13864	72344	35 20N	084 23W	0141	01 56 - 12 72	STAR	SA	T14055
LITTLE ROCK	ROAMS FIELD FAR WARS	AR	13863	72340	34 44N	082 14W	0084	01 55 - 12 64	STAR	SA	T14044
LITTLE ROCK	ROAMS FIELD FAR WARS	AR	13863	72340	34 44N	082 14W	0084	01 56 - 12 70	STAR	SA	T13028
LITTLE ROCK	ROAMS FIELD FAR WARS	AR	13863	72340	34 44N	082 14W	0084	01 66 - 12 73	STAR	SA	T51040.3
LITTLE ROCK	ROAMS FIELD FAR WARS	AR	13863	72340	34 44N	082 14W	0084	01 67 - 12 73	STAR	SA	T11153
ALAMEDA	FAR	CA	23236	74906	37 47N	122 18W	0008	01 50 - 12 64	STAR	TR	T14268
AGCARA	FAR	CA	24263		40 58N	124 08W	0068	01 50 - 12 72	STAR	TR	T14260
BAKERSFIELD	PEAKS FIELD WARS	CA	23155	72384	39 25N	118 02W	0151	01 60 - 12 64	STAR	A	T52295
BAKERSFIELD	PEAKS FIELD WARS	CA	23155	72384	39 25N	118 02W	0151	01 64 - 12 73	STAR	TR	T50715.3
SISIOP	WARS	CA	23195	72384	39 25N	118 02W	0151	01 67 - 12 71	STAR	TR	T14231
SLYTMC	RIVERSIDE COUNTY ART FAR	CA	23197	72400	37 22N	118 22W	1253	01 50 - 12 64	STAR	TR	T15158.474
SLYTMC	RIVERSIDE COUNTY ART FAR	CA	23198		33 27N	114 43W	2120	01 49 - 12 54	STAR	SA	T14256
SUBURBAN	HOLL TWO-SUBURB ART WARS	CA	23154		33 37N	114 43W	0118	01 56 - 12 54	STAR	SA	T15211
CHINA LAKE	FAR	CA	93104		35 41N	117 41W	0680	01 54 - 12 56	STAR	TR	T13257
CHINA LAKE	FAR	CA	93104		35 41N	117 41W	0682	01 56 - 12 63	STAR	TR	T15276
JAGGETT	SAN SERNAROING CAR FAR	CA	23181		34 52N	116 47W	0580	01 55 - 12 64	STAR	SA	T12264
JAGGETT	SAN SERNAROING CAR FAR	CA	23181		34 52N	116 47W	0580	01 55 - 12 64	STAR	TR	T12264
EDWARDS	AFB MURC	CA	23114	72381	34 59N	117 54W	3708	01 56 - 12 70	STAR	TR	T11144
FATFIELD	TRAVIS AFB	CA	23202	74516	36 16N	121 56W	2018	01 50 - 12 64	STAR	TR	T14230
FRESNO	AIR TERMINAL WARS	CA	23183	72389	36 47N	119 42W	0103	01 50 - 12 64	STAR	A	T52295
LONG BEACH	MUNICIPAL ART WARS	CA	23183	72389	36 47N	119 42W	0103	01 50 - 12 64	STAR	TR	T15358.3
LONG BEACH	MUNICIPAL ART WARS	CA	23129	72297	33 46N	118 39W	0201	01 46 - 12 64	STAR	TR	T15332.3
LONG BEACH	MUNICIPAL ART WARS	CA	23129	72297	33 46N	118 39W	0201	01 50 - 12 64	STAR	TR	T15257
LDS ALAMETOS	FAR	CA	23129	72297	33 46N	118 39W	0201	01 55 - 12 74	STAR	TR	T15332.3
LS ANGELES	INTERNATIONAL ART WARS	CA	23174	72295	33 56N	118 33W	0008	01 58 - 12 73	STAR	A	T50619.3
LS ANGELES	INTERNATIONAL ART WARS	CA	23174	72295	33 56N	118 33W	0008	01 55 - 12 64	STAR	TR	T12257
LS ANGELES	INTERNATIONAL ART WARS	CA	23174	72295	33 56N	118 33W	0008	01 55 - 12 64	STAR	TR	T50249
LS ANGELES	INTERNATIONAL ART WARS	CA	23174	72295	33 56N	118 33W	0007	01 50 - 12 61	STAR	TR	T14088
LS ANGELES	INTERNATIONAL ART WARS	CA	23174	72295	33 56N	118 33W	0007	01 55 - 12 68	STAR	TR	T12257
TOFFETT FIELD	FAR SUNNYVALE	CA	23244	72408	37 25N	122 03W	0013	01 50 - 12 64	STAR	TR	T14289
NEEDLES	MUNICIPAL ART CAR	CA	23179	72380	34 46N	114 37W	0260	01 49 - 12 54	STAR	SA	T13029
NEEDLES	MUNICIPAL ART CAR	CA	23179	72380	34 46N	114 37W	0260	01 55 - 12 64	STAR	SA	T13790
NEEDLES	MUNICIPAL ART FAR	CA	23179	72380	34 46N	114 37W	0260	01 56 - 12 70	STAR	SA	T14211
IRALAND	INTERNATIONAL ART WARS	CA	23230	72493	37 44N	122 22W	0005	01 50 - 12 64	STAR	TR	T14269
JOHARD	FAR	CA	23138		34 13N	119 34W	2025	01 50 - 12 64	STAR	TR	T14268
JOINT TUGU	FAR	CA	93111	72381	34 37N	119 37W	0004	01 52 - 12 72	STAR	TR	T15332.3
JOINT TUGU	FAR	CA	93111	72381	34 37N	119 37W	0004	01 52 - 12 64	STAR	TR	T50518
RIVERSIDE	TRACX AFB	CA	23119	72286	33 53N	117 15W	0481	01 56 - 12 70	STAR	A	T50819.3
RIVERSIDE	TRACX AFB	CA	23119	72286	33 53N	117 15W	0481	01 56 - 12 70	STAR	TR	T14331
SACRAMENTO	MUNICIPAL ART WARS	CA	23232	72403	38 31N	121 30W	0013	01 54 - 12 70	STAR	SA	T1772

CITY	NAME - TYPE	ST	S	E	LAT	LONG	ELEV.	PC100	SF	SUMMARY	SUMM	SFCB	
												REC#	TAB#
SACRAMENTO	EXECUTIVE APT WRS	CA	23232	72-483	38 31N	121 30W	3008	31 50	-12 73	STAR	SA	TS0504-47F	
SACRAMENTO	EXECUTIVE APT WRS	CA	23232	72-483	38 31N	121 30W	3009	31 50	-12 73	STAR	SA	TS0504-47G	
SAN DIEGO	LINDBERGH INL APT WRS	CA	23186	72290	32 44N	117 10W	3011	31 55	-12 54	STAR	SA	TS024-4	
SAN DIEGO	LINDBERGH INL APT WRS	CA	23186	72290	32 44N	117 10W	3011	31 50	-12 54	STAR	SA	TS1269	
SAN DIEGO	LINDBERGH INL APT WRS	CA	23186	72290	32 44N	117 10W	3011	31 50	-12 72	STAR	SA	TS1772	
SAN DIEGO	NAS NORTH ISLAND	CA	23112	72-42N	31 57	124 12W	3015	31 57	-12 71	STAR	SA	775000	
SAN FRANCISCO	INTERNATIONAL APT WRS	CA	23234	72-484	37 37N	122 23W	3027	31 50	-12 54	STAR	SA	714299	
SAN FRANCISCO	INTERNATIONAL APT WRS	CA	23234	72-484	37 37N	122 23W	3002	31 58	-12 73	STAR	SA	TS0879-47C	
SAN FRANCISCO	INTERNATIONAL APT WRS	CA	23234	72-484	37 37N	122 23W	3002	31 58	-12 73	STAR	SA	TS0875-47B	
SAN FRANCISCO	INTERNATIONAL APT WRS	CA	23234	72-484	37 37N	122 23W	3002	31 58	-12 73	STAR	SA	TS0875-47A	
SAN FRANCISCO	INTERNATIONAL APT WRS	CA	23234	72-484	37 37N	122 23W	3002	31 58	-12 73	STAR	SA	TS0875-47D	
SAN RAYNAL	HAMILTON AFB	CA	23211	38 04N	122 31W	3004	31 50	-12 54	STAR	SA	714286		
SANTA BARBARA	MUNICIPAL APT FAR	CA	23180	38 54N	122 31W	3004	31 50	-12 70	STAR	SA	714154		
SANTA MARIA	WRS	CA	23236	72294	34 58N	120 29W	3071	31 49	-12 53	STAR	SA	TS0740	
UKIAH	MUNICIPAL APT FAR	CA	23273	72294	34 54N	120 27W	3073	31 55	-12 74	STAR	SA	TS2110-3	
VANCOUVER	CAMP COKE AFB	CA	93214	72383	34 43N	120 34W	0116	31 58	-12 72	STAR	SA	715332-3	
VANCOUVER	CAMP COKE AFB	CA	93214	72383	34 43N	120 34W	0116	31 58	-12 70	STAR	SA	TS19028	
VANCOUVER	CAMP COKE AFB	CA	93214	72383	34 43N	120 34W	0116	31 58	-12 70	STAR	SA	TS0008-47E	
VANCOUVER	CAMP COKE AFB SURF	CA	93214	72383	34 43N	120 34W	0116	31 70	-12 70	STAR	SA	TS1772	
VICTORVILLE	GEORGE AFB	CA	23131	34 35N	117 23W	0880	31 58	-12 87	STAR	SA	713264		
VICTORVILLE	GEORGE AFB	CA	23131	34 35N	117 23W	0880	31 58	-12 87	STAR	SA	TS13284		
AKRON	WASHINGTON COUNTY APT CAR	CO	24015	40 07N	103 10W	1300	31 50	-12 54	STAR	SA	TS0508		
COLORADO SPRGS	PETERSON FIELD WRS	CO	93037	72468	38 48N	104 43W	1857	31 50	-12 73	STAR	SA	TS0235	
COLORADO SPRGS	PETERSON FIELD WRS	CO	93037	72-468	38 48N	104 43W	1857	31 74	-12 74	STAR	A	TS1847-3	
DENVER	STAPLETON INT APT WRS	CO	23082	72-468	38 48N	104 50W	1615	31 50	-12 54	STAR	SA	TS0213	
DENVER	STAPLETON INT APT WRS	CO	23082	72-468	38 48N	104 50W	1615	31 50	-12 60	STAR	A	TI2211	
DENVER	STAPLETON INL APT WRS	CO	23082	72-468	38 48N	104 50W	1615	31 74	-12 74	STAR	SA	TS1859-3	
GRAND JUNCTION	MUNICIPAL APT WRS	CO	23084	72476	38 07N	104 33W	1474	31 50	-12 54	STAR	SA	714518	
PUEBLO	MEMORIAL APT WRS	CO	93056	72-464	38 17N	104 31W	1419	31 50	-12 64	STAR	SA	TS0807	
PUEBLO	MEMORIAL APT WRS	CO	93056	72-464	38 17N	104 31W	1419	31 58	-12 70	STAR	SA	TS0008	
PUEBLO	MEMORIAL APT WRS	CO	93056	72-464	38 17N	104 31W	1438	31 73	-12 74	STAR	A	TI1405	
PUEBLO	MEMORIAL APT WRS	CO	93056	72-464	38 17N	104 31W	1438	31 74	-12 74	STAR	A	TS1947-3	
BRIDGEPORT	MUNICIPAL APT WRS	CT	24702	72504	41 10N	073 08W	0008	31 54	-12 54	STAR	A	TI2243	
BRIDGEPORT	MUNICIPAL APT WRS	CT	24702	72504	41 10N	073 08W	0008	31 55	-12 60	STAR	SA	TI4703	
HARTFORD	BRAEMAR FIELD WRS	CT	14752	41 44N	072 38W	0006	01 46	-12 52	STAR	SA	TI4204		
WINOSKOR LOCKS	BRADLEY FIELD WRS	CT	14740	72508	41 56N	072 41W	0061	01 58	-12 72	STAR	SA	TI4703	
WINOSKOR LOCKS	BRADLEY FIELD WRS	CT	14740	72508	41 56N	072 41W	0061	05 73	-04 74	STAR	A	TS0465	
WINOSKOR LOCKS	BRADLEY FIELD WRS	CT	14740	72508	41 56N	072 41W	0061	01 74	-04 79	STAR	SA	TI1792	
WINOSKOR LOCKS	BRADLEY FIELD WRS	CT	14740	72508	41 56N	072 41W	0061	05 74	-01 74	STAR	A	TS2444-52	
DOVER	AFB	DE	13707	38 08N	075 28W	3011	31 63	-12 67	STAR	A	TI1744		
DOVER	AFB	DE	13707	38 08N	075 28W	3011	31 68	-12 70	STAR	SA	TS0405-3		
DOVER	AFB	DE	13707	38 08N	075 28W	3011	37 74	-06 75	STAR	SA	TS2367		
WILMINGTON	STR MIL NEW CAS APT WRS	DE	13781	38 40N	075 38W	0229	31 60	-12 54	STAR	SA	TI3187		
WILMINGTON	STR MIL NEW CAS APT WRS	DE	13781	38 40N	075 38W	0224	31 50	-12 54	STAR	SA	TS1634		
WILMINGTON	STR MIL NEW CAS APT WRS	DE	13781	38 40N	075 38W	0228	31 57	-12 57	STAR	SA	TI1776		
WILMINGTON	STR MIL NEW CAS APT WRS	DE	13781	38 40N	075 38W	0224	31 60	-12 73	STAR	SA	TS0499		
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 50	-12 54	STAR	A	TI1451-47X	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 50	-12 54	STAR	A	TI1451-47I	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 50	-12 54	STAR	A	TI1451-47L	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 50	-12 54	STAR	A	TI3371	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 60	-12 54	STAR	A	TI1451-47J	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 66	-12 72	STAR	SA	TS0766-47J	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 66	-12 72	STAR	SA	TI1473	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 68	-12 72	STAR	SA	TI1473	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 68	-12 72	STAR	SA	TS1800-3	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 70	-12 70	STAR	SA	TI3770	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 70	-12 70	STAR	SA	TI3770	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 71	-12 71	STAR	SA	TI1772	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 72	-12 72	STAR	SA	TI1772	
WASHINGTON	NATIONAL APT WRS	DC	13743	72405	38 51N	077 02W	3023	31 73	-12 73	STAR	A	TS1500-3	
WASHINGTON	DULLES INL APT WRS	DC	13738	72403	38 57N	077 27W	0094	01 66	-12 70	STAR	SA	TI3303	
WASHINGTON	DULLES INL APT WRS	DC	13738	72403	38 57N	077 27W	0094	01 67	-12 71	STAR	SA	TI2872	
WASHINGTON	DULLES INL APT WRS	DC	13738	72403	38 57N	077 27W	0094	01 70	-12 71	STAR	SA	TI4465	
WASHINGTON	DULLES INL APT WRS	DC	13738	72403	38 57N	077 27W	0094	01 71	-12 71	STAR	A	TI4175	
WASHINGTON	DULLES INL APT WRS	DC	13738	72403	38 57N	077 27W	0094	01 72	-12 72	STAR	A	TI4175	
DAYTONA BEACH	MUNICIPAL APT WRS	FL	12834	29 11N	081 03W	0015	01 67	-12 71	STAR	SA	TS0033		
FORT MYERS	PAGE FIELD WRS	FL	12835	72210	26 35N	081 52W	0004	01 59	-12 73	STAR	A	TS0872	
JACKSONVILLE	SPESON APT WRS	FL	13888	72208	30 25N	081 39W	0012	31 66	-12 56	STAR	SA	TI2056	
JACKSONVILLE	SPESON APT WRS	FL	13888	72208	30 25N	081 39W	0012	31 70	-12 70	STAR	SA	TI2056	
JACKSONVILLE	SPESON APT WRS	FL	13888	72208	30 25N	081 39W	0012	01 72	-12 72	STAR	SA	TI2172	
JACKSONVILLE	SPESON APT WRS	FL	13888	72208	30 25N	081 39W	0012	31 73	-12 73	STAR	SA	TS0163	
JACKSONVILLE	SPESON APT WRS	FL	13888	72208	30 25N	081 39W	0008	01 75	-12 75	STAR	A	TS2247	
MIRMI	INTERNATIONAL APT WRS	FL	12839	72202	25 44N	080 16W	3004	01 67	-12 71	STAR	SA	TI3861	
MIRMI	INTERNATIONAL APT	FL	12839	72202	25 46N	080 16W	3004	01 70	-12 74	STAR	A	TS2115-3	
MIRMI	INTERNATIONAL APT	FL	12839	72202	25 46N	080 16W	3004	01 71	-12 71	STAR	SA	TI3861	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3004	01 72	-12 72	STAR	SA	TI1772	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3004	31 73	-12 73	STAR	A	TS0163	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3017	31 74	-12 74	STAR	A	TS2115-3	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3017	36 74	-06 75	STAR	A	TS1924-3	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3017	33 75	-12 75	STAR	A	TS1924-3	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3017	33 75	-12 75	STAR	SA	TI1457	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3032	01 52	-12 71	STAR	SA	TI1772	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3032	01 56	-12 57	STAR	SA	TI1772	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3032	01 70	-12 70	STAR	SA	TI1772	
MIRMI	INTERNATIONAL	FL	12839	72202	25 46N	080 16W	3032	01 74	-12 74	STAR	A	TS1346-56	

CITY	NAME - TYPE	ST.	LAT			LONG			ELEV.	PERIOD	REC'D	SUMMARY	TYPE	SUM REC'D	REMARKS
			E	N	S	W	E	W							
JEL ALMOO	MORN MOON APT WOAS	FL	22841	72205	29 33N	281 20W	2037	31 50	-12 54	STAR	A	711749			
JEL ALMOO	MORN MOON APT WOAS	FL	22841	72205	28 33N	281 20W	2037	31 50	-12 54	STAR	A	730580			
JEL ALMOO	MORN MOON APT WOAS	FL	22841	72205	28 33N	281 20W	2037	31 50	-12 54	STAR	A	714455			
JEL ALMOO	MORN MOON APT WOAS	FL	22841	72205	28 33N	281 20W	2037	31 50	-12 54	STAR	A	711772			
JEL ALMOO	MORN MOON APT WOAS	FL	22841	72205	28 33N	281 20W	2037	31 50	-12 54	STAR	A	730241			
PENSACOLA	FOREST SHERMAN WOAS	FL	23855	72222	30 04N	289 35W	2007	31 54	-12 70	STAR	A	714171			
PENSACOLA	FOREST SHERMAN WOAS	FL	23855	72222	30 04N	289 35W	2010	31 57	-12 71	STAR	A	287			
TALLAHASSEE	MUNICIPAL APT WOAS	FL	23805	72214	30 23N	087 18W	2021	01 50	-12 74	STAR	A	732119.3			
TALLAHASSEE	MUNICIPAL APT WOAS	FL	23805	72214	30 23N	087 18W	2021	01 50	-12 74	STAR	A	730590			
TALLAHASSEE	MUNICIPAL APT WOAS	FL	23805	72214	30 23N	087 18W	2021	01 50	-12 74	STAR	A	730413			
TALLAHASSEE	MUNICIPAL APT WOAS	FL	23805	72214	30 23N	087 18W	2021	01 50	-12 74	STAR	A	730014			
TAMPA	MCCOILL APT	FL	12810	74786	27 51N	082 30W	0008	01 55	-12 68	STAR	A	730830			
TAMPA	MCCOILL APT	FL	12810	74786	27 51N	082 30W	0008	01 50	-12 70	STAR	A	712057			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0010	01 50	-12 64	STAR	A	730580			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0010	01 55	-12 69	STAR	A	712026			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0010	01 50	-12 73	STAR	A	715377			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0010	01 51	-12 71	STAR	A	714113			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0010	01 52	-12 72	STAR	A	714346			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0010	01 52	-12 72	STAR	A	733367			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0010	01 52	-12 72	STAR	A	730830			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0003	01 53	-12 73	STAR	A	730407.3			
TAMPA	INTERNATIONAL APT WOAS	FL	12842	72211	27 56N	082 12W	0010	01 51	-12 73	STAR	A	730413			
WEST PALM BEACH	INTERNATIONAL APT WOAS	FL	12844	72203	26 41N	080 06W	0008	01 50	-12 70	STAR	A	71184			
ALBANY	TURNER APT	GA	13815		31 35N	084 05W	0088	01 52	-12 66	STAR	SA	714372			
ALBANY	WOS	GA	13815		31 35N	084 05W	0088	01 55	-12 73	STAR	SA	715175.3			
ALBANY	WOS	GA	13815		31 35N	084 05W	0088	01 55	-12 60	STAR	SA	730600.3			
ALBANY	WOS	GA	13815		31 35N	084 05W	0088	01 55	-04 74	STAR	SA	730680.3			
ALBANY	WOS	GA	13815		31 35N	084 05W	0088	01 50	-12 70	STAR	SA	730680.3			
ALBANY	WOS	GA	13815		31 35N	084 05W	0088	01 50	-12 70	STAR	SA	713252			
ALBANY	WOS	GA	13815		31 35N	084 05W	0088	01 51	-12 71	STAR	SA	730680.3			
ALBANY	WOS	GA	13815		31 35N	084 05W	0088	01 52	-12 72	STAR	SA	730680.3			
ALBANY	WOS	GA	13815		31 35N	084 05W	0088	01 52	-12 73	STAR	SA	730680.3			
ATHENS	BACON COUNTY APT CAR	GA	13870		31 32N	082 31W	0082	01 54	-12 58	STAR	SA	715175.3			
ATHENS	SEN CROS FIELD WOAS	GA	13873	72211	33 57N	083 16W	0247	01 60	-12 73	STAR	SA	713252			
ATLANTA	LEADS	GA	13874	72216	33 59N	083 25W	0302	01 50	-12 63	STAR	SA	712688			
ATLANTA	LEADS	GA	13874	72216	33 59N	084 26W	0311	01 57	-12 71	STAR	SA	715177.3			
ATLANTA	LEADS	GA	13874	72216	33 59N	084 26W	0315	01 58	-12 73	STAR	SA	715175.3			
ATLANTA	LEADS	GA	13874	72216	33 59N	084 26W	0311	01 50	-12 70	STAR	SA	717772			
ATLANTA	LEADS	GA	13874	72216	33 59N	084 26W	0311	01 50	-12 70	STAR	SA	713404			
AUGUSTA	BUSH FIELD WOAS	GA	13874	72216	33 59N	084 26W	0311	01 52	-12 72	STAR	SA	714308			
AUGUSTA	BUSH FIELD WOAS	GA	13880	72216	33 59N	084 26W	0311	01 56	-06 74	STAR	A	731138			
AUGUSTA	BUSH FIELD WOAS	GA	13880	72216	33 59N	084 26W	0309	01 55	-12 55	STAR	SA	701271			
AUGUSTA	BUSH FIELD WOAS	GA	13880	72216	33 59N	084 26W	0309	01 57	-12 71	STAR	SA	714010			
AUGUSTA	BUSH FIELD WOAS	GA	13880	72216	33 59N	084 26W	0309	01 58	-12 73	STAR	SA	715175.3			
AUGUSTA	BUSH FIELD WOAS	GA	13880	72216	33 59N	084 26W	0309	01 52	-12 70	STAR	SA	73252			
BRUNSWICK	GLYNCO WOS	GA	03820	72216	33 22N	081 58W	0045	01 75	-12 75	STAR	SA	714290			
BRUNSWICK	GLYNCO WOS	GA	03820	72216	33 22N	081 58W	0045	01 76	-03 76	STAR	SA	715002			
COLUMBUS	PETRODOLPHIN APT WOAS	GA	03836		31 15N	083 28W	0010	01 67	-12 71	STAR	SA	715073.52			
COLUMBUS	PETRODOLPHIN APT WOAS	GA	03842		32 31N	084 56W	0123	01 67	-12 71	STAR	SA	715175.3			
MACON	LEWIS & WILSON APT WOAS	GA	03813	72217	32 42N	083 39W	0110	01 57	-12 71	STAR	SA	714041			
MACON	LEWIS & WILSON APT WOAS	GA	03813	72217	32 42N	083 39W	0110	01 58	-12 73	STAR	SA	714372			
SAVANNAH	TRAVIS FLD HWD WOAS	GA	03813	72217	32 42N	083 39W	0110	01 58	-12 73	STAR	SA	715175.3			
SAVANNAH	TRAVIS FLD HWD WOAS	GA	03822	72207	32 08N	081 12W	0018	01 58	-12 70	STAR	SA	712252			
SAVANNAH	TRAVIS FLD HWD WOAS	GA	03822	72207	32 08N	081 12W	0018	01 67	-12 71	STAR	SA	712050			
SAVANNAH	TRAVIS FLD HWD WOAS	GA	03822	72207	32 08N	081 12W	0018	01 67	-12 71	STAR	SA	71-085			
SAVANNAH	TRAVIS FLD HWD WOAS	GA	03822	72207	32 08N	081 12W	0018	01 68	-12 73	STAR	SA	715175.3			
SAVANNAH	TRAVIS FLD HWD WOAS	GA	03822	72207	32 08N	081 12W	0018	01 70	-12 70	STAR	SA	715177.3			
SAVANNAH	TRAVIS FLD HWD WOAS	GA	03822	72207	32 08N	081 12W	0018	01 70	-12 70	STAR	SA	701272			
SAVANNAH	TRAVIS FLD HWD WOAS	GA	03822	72207	32 08N	081 12W	0018	01 72	-12 72	STAR	SA	714390			
SAVANNAH	HUNTER APT	GA	13824		32 01N	081 06W	0018	01 75	-12 75	STAR	A	732184			
SABERS POINT	WOS	GA	22914	81176	21 18N	156 04W	0015	01 52	-12 72	STAR	SA	715175.3			
MILD	WOS	GA	22914	81176	21 18N	156 04W	0015	01 57	-12 71	STAR	SA	730709			
HONOLULU	LTTM FIELD WOAS	HI	21904	91285	19 43N	195 34W	0010	08 42	-07 67	STAR	SA	701212			
CHAMULU	JOHN ROGERS INL APT WOAS	HI	22521	91182	21 31N	157 56W	0212	01 40	-12 64	STAR	SA	712223			
JIJUHERE	CAR	HI	22518	91180	20 54N	156 26W	0015	01 46	-12 70	STAR	SA	713223			
BOISSE	FUNDING FIELD CAR	HI	24131	72681	43 34N	118 13W	0870	01 60	-12 64	STAR	SA	730544			
IRVING FALLS	FUNDING FIELD CAR	HI	24149		43 31N	112 04W	1446	01 59	-12 64	STAR	SA	731224.3			
MOUNTAIN HOME	AFS	HI	24151		42 10N	112 19W	1368	01 49	-12 54	STAR	SA	731224.3			
POCATELLI	MUNICIPAL APT WOAS	ID	24108		43 03N	115 52W	0812	01 55	-12 69	STAR	SA	730544			
POCATELLI	MUNICIPAL APT WOAS	ID	24156	72578	42 55N	112 26W	1356	01 55	-12 54	STAR	SA	731224.3-60			
POCATELLI	MUNICIPAL APT WOAS	ID	24156	72578	42 55N	112 26W	1356	01 56	-12 62	STAR	SA	730870			
SELBYVILLE	SCOTT APT	IL	13802		38 33N	089 51W	0105	01 51	-12 70	STAR	SA	731223.3			
CHICAGO	TICLAT APT WOAS	IL	14016	72534	41 47N	087 49W	2167	01 54	-12 73	STAR	SA	730448			
CHICAGO	TICLAT APT WOAS	IL	14016	72534	41 47N	087 49W	2167	01 54	-12 73	STAR	SA	730404			
CHICAGO	TICLAT APT WOAS	IL	14016	72534	41 47N	087 49W	2167	01 57	-12 57	STAR	SA	711930			



CITY	NAME - TYPE	ST	LAT		LONG		ELEV	PERIOD	SF	SUMMARY	SUM
			S	N	E	W				TYPE	FREQ
LOUISVILLE	STANIFORD FIELD -MWS	KY	33821	72423	38 1IN	085 44W	3148	31 70	- 12 701	STAR	SA
LOUISVILLE	STANIFORD FIELD -MWS	KY	33821	72423	38 1IN	085 44W	3148	31 72	- 12 721	STAR	A
LOUISVILLE	STANIFORD FIELD -MWS	KY	33821	72423	38 1IN	085 44W	3148	31 73	- 12 731	STAR	SA
BROUARD	BARKLEY APT CAR	KY	33816	72424	37 2IN	086 44W	3121	31 50	- 12 54	STAR	SA
BROUARD	BARKLEY APT CFS	KY	33816	72424	37 2IN	086 44W	3121	31 55	- 12 54	STAR	A
BROUARD	BARKLEY APT CFS	KY	33816	72424	37 2IN	086 44W	3121	31 50	- 12 54	STAR	SA
ALEXANDRIA	ESLER FIELD	LA	13825	72240	31 2IN	082 08W	0028	31 70	- 12 73	STAR	SA
ALEXANDRIA	ESLER FIELD	LA	13825	72240	31 2IN	082 08W	0028	31 70	- 12 74	STAR	SA
BATON ROUGE	RYAN FIELD -MWS	LA	13870	72240	30 3IN	081 08W	0024	31 55	- 12 54	STAR	PR
BATON ROUGE	RYAN FIELD -MWS	LA	13870	72240	30 3IN	081 08W	0024	31 56	- 12 70	STAR	A
BATON ROUGE	RYAN FIELD -MWS	LA	13870	72240	30 3IN	081 08W	0024	31 70	- 12 70	STAR	SA
BATON ROUGE	RYAN FIELD -MWS	LA	13870	72240	30 3IN	081 08W	0024	31 72	- 12 72	STAR	PR
BATON ROUGE	RYAN FIELD -MWS	LA	13870	72240	30 3IN	081 08W	0023	31 72	- 12 72	STAR	A
LAFAYETTE	MUNICIPAL APT CAR	LA	13876	72240	30 1IN	081 08W	0023	31 72	- 12 72	STAR	SA
LAKE CHARLES	MUNICIPAL APT MWS	LA	13837	72240	30 07N	083 13W	0005	31 64	- 12 70	STAR	A
LAKE CHARLES	MUNICIPAL APT MWS	LA	13837	72240	30 07N	083 13W	0005	31 56	- 12 70	STAR	A
LAKE CHARLES	MUNICIPAL APT MWS	LA	13837	72240	30 07N	083 13W	0005	31 70	- 12 70	STAR	A
LAKE CHARLES	MUNICIPAL APT MWS	LA	13837	72240	30 07N	083 13W	0005	31 74	- 12 74	STAR	SA
LAKE CHARLES	MWS	LA	13841	72240	30 1IN	083 08W	0005	31 54	- 12 62	STAR	PR
PONDER	SELMA FIELD CAR	LA	13842	72240	32 3IN	082 03W	0028	31 54	- 12 58	STAR	SA
PONDER	SELMA FIELD CAR	LA	13842	72240	32 3IN	082 03W	0028	31 54	- 12 58	STAR	SA
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0008	31 60	- 12 54	STAR	PR
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 68	- 12 70	STAR	A
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 67	- 12 71	STAR	PR
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 68	- 12 73	STAR	SA
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 68	- 12 73	STAR	PR
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 70	- 12 70	STAR	A
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 74	- 12 74	STAR	PR
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 75	- 12 75	STAR	SA
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 75	- 12 75	STAR	PR
NEW ORLEANS	POISSANT INL APT MWS	LA	12816	72231	28 5IN	080 13W	0006	31 76	- 05 76	STAR	PR
NEW ORLEANS	CALLENDAR MWS	LA	12856	72240	28 5IN	080 01W	0001	31 67	- 12 71	STAR	SA
NEW ORLEANS	CALLENDAR MWS	LA	12856	72240	28 5IN	080 01W	0001	31 70	- 12 74	STAR	SA
SHREVEPORT	MUNICIPAL APT MWS	LA	13857	72240	32 2IN	083 46W	0081	31 60	- 12 54	STAR	A
SHREVEPORT	MUNICIPAL APT MWS	LA	13857	72240	32 2IN	083 46W	0081	31 67	- 12 71	STAR	SA
SHREVEPORT	MUNICIPAL APT MWS	LA	13857	72240	32 2IN	083 46W	0081	31 70	- 12 74	STAR	PR
SHREVEPORT	MUNICIPAL APT MWS	LA	13857	72240	32 2IN	083 46W	0081	31 71	- 12 79	STAR	SA
SHREVEPORT	MUNICIPAL APT MWS	LA	13857	72240	32 2IN	083 46W	0081	31 72	- 12 72	STAR	PR
SHREVEPORT	MUNICIPAL APT MWS	LA	13857	72240	32 2IN	083 46W	0081	31 75	- 12 75	STAR	SA
SHREVEPORT	MUNICIPAL APT MWS	LA	13857	72240	32 2IN	083 46W	0081	31 75	- 12 75	STAR	PR
AUGUSTA	STATE APT CAR	PE	14605	72240	44 1IN	088 46W	0108	31 50	- 12 54	STAR	SA
AUGUSTA	STATE APT CAR	PE	14605	72240	44 1IN	088 46W	0108	31 50	- 12 54	STAR	MSA
AUGUSTA	STATE APT CAR	PE	14605	72240	44 1IN	088 46W	0108	31 50	- 12 54	STAR	TS004
SRUNSWICK	MWS	PE	14611	72302	43 5IN	088 46W	0024	31 50	- 12 68	STAR	SA
CARIBOU	MUNICIPAL APT MWS	PE	14607	72712	44 5IN	088 01W	0181	31 53	- 12 62	STAR	TS137
SLD TOWT	FAR	PE	14622	72712	44 5IN	088 01W	0041	31 50	- 12 64	STAR	TS009
PORTLAND	INTERNATIONAL APT MWS	PE	14764	72608	43 3IN	070 18W	0024	31 60	- 12 54	STAR	SA
PORTLAND	INTERNATIONAL APT MWS	PE	14764	72608	43 3IN	070 18W	0024	31 73	- 08 74	STAR	PR
ABERDEEN	PHILLIPS FIELD AAF	PE	13701	72403	38 2IN	076 16W	0018	31 55	- 12 57	STAR	PR
ABERDEEN	WASHINGTON DC	PE	13705	72403	38 4IN	076 53W	0086	31 66	- 12 70	STAR	PR
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 50	- 12 64	STAR	SA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 60	- 12 54	STAR	A
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 60	- 12 54	STAR	SA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 60	- 12 64	STAR	SA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 60	- 12 64	STAR	PR
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 64	- 12 54	STAR	SA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 68	- 12 73	STAR	PR
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 70	- 12 70	STAR	MSA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 70	- 12 70	STAR	TS137
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 71	- 12 71	STAR	MSA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 72	- 12 72	STAR	TS141
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 73	- 12 73	STAR	TS028
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0047	31 74	- 12 74	STAR	MSA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0047	31 74	- 12 74	STAR	TS126
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0047	31 75	- 12 75	STAR	A
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0047	31 76	- 12 60	STAR	MSA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 70	- 12 70	STAR	TS137
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 71	- 12 71	STAR	MSA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 72	- 12 72	STAR	TS141
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0060	31 73	- 12 73	STAR	TS028
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0047	31 74	- 12 74	STAR	MSA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0047	31 75	- 12 75	STAR	TS126
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0047	31 76	- 12 62	STAR	SA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0043	31 50	- 12 64	STAR	SA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0043	31 50	- 12 64	STAR	SA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0043	31 60	- 12 64	STAR	SA
SALT TIPOR	FRIENDSHIP INL APT MWS	PE	13721	72408	38 1IN	076 40W	0043	31 60	- 12 64	STAR	SA
HAGERSTOWN	MUNICIPAL APT SAME	PE	13708	72721	38 4IN	077 43W	0219	31 74	- 12 74	STAR	MSA
PUTNAM RIVER	MWS	PE	13721	72404	38 1IN	076 25W	3014	31 53	- 12 72	STAR	PR
PUTNAM RIVER	MWS	PE	13721	72404	38 1IN	076 25W	3014	31 67	- 12 71	STAR	TS023
PUTNAM RIVER	MWS	PE	13721	72404	38 1IN	076 25W	3014	31 68	- 12 58	STAR	MSA
PUTNAM RIVER	MWS	PE	13721	72404	38 1IN	076 25W	3014	31 70	- 12 70	STAR	TS145
PUTNAM RIVER	MWS	PE	13721	72404	38 1IN	076 25W	3014	31 71	- 12 71	STAR	MSA
PUTNAM RIVER	MWS	PE	13721	72404	38 1IN	076 25W	3014	31 72	- 12 72	STAR	TS147
SALISBURY	WICOMICO COUNTY APT CAR	PE	13720	72720	38 2IN	075 30W	3021	31 49	- 12 58	STAR	MSA
SALISBURY	WICOMICO COUNTY APT CAR	PE	13720	72720	38 2IN	075 30W	3016	31 74	- 12 74	STAR	TS129
BEDFORD	L G WILSON FIELD AFB	PE	14702	72400	42 4IN	071 17W	3049	31 53	- 12 67	STAR	SA
BOSTON	LOGAN INL APT MWS	PE	14738	72509	42 2IN	071 32W	3009	31 56	- 12 70	STAR	SA
BOSTON	LOGAN INL APT MWS	PE	14738	72509	42 2IN	071 32W	3009	31 57	- 12 71	STAR	SA

CITY	NAME - TYPE	ST	WKR	LTC	ST	LAT	LONG	ELEV	PERIOD	OF	SUMMARY	SUM	FREQ	LASTUPDTHRS
									ACCDR	REC	TYPE			
BOSTON	JOHN M. APT - WRS	MA	14720	72500	42 22N	71 32W	3000	31 72 - 12 72	STAR	SA	T50555			
CHICAGO FALLS	WESTOVER AFB	PA	14703	74491	42 12N	372 32W	31 60	32 64	STAR	SA	T51722			
CHICAGO FALLS	WESTOVER AFB	PA	14703	74491	42 12N	372 32W	3075	31 50 - 12 58	STAR	SA	T50572			
FALMOUTH	3713 AFB	PA	14704	38N	370 31W	3042	31 50 - 12 54	STAR	SA	T50421				
PITTSFIELD	MUNICIPAL APT CAR	PA	14763	42 28N	073 18W	3058	31 48 - 12 58	STAR	SA	T51018				
SOUTH Weymouth	WRS	PA	14780	42 38N	070 56W	2051	31 70 - 12 74	STAR	SA	T52284.3				
WORCESTER	MUNICIPAL APT - WRS	PA	14746	42 18N	071 52W	3310	31 59 - 12 58	STAR	SA	T51927				
WORCESTER	MUNICIPAL APT - WRS	PA	14746	42 18N	071 52W	3310	31 72 - 12 72	STAR	SA	T50555				
WORCESTER	MUNICIPAL APT - WRS	PA	14746	42 18N	071 52W	3310	05 74 - 04 75	STAR	SA	T51782				
DETROIT HARBOR	BOSS FIELD	MI	24671	42 08N	366 28W	3181	01 74 - 12 74	STAR	SA	T51045.47N				
DETROIT	CITY APT - WRS	MI	14622	42 29N	363 01W	3181	31 60 - 12 73	STAR	A	T5016				
DETROIT	CITY APT - WRS	MI	14622	42 29N	363 01W	3181	01 72 - 12 72	STAR	SA	T50049				
DETROIT	CITY APT - WRS	MI	14622	42 29N	363 01W	3181	01 74 - 12 74	STAR	SA	T51026				
DETROIT	CITY APT - WRS	MI	14622	42 29N	363 01W	3181	01 75 - 12 75	STAR	SA	T51021				
DETROIT	CITY APT - WRS	MI	14622	42 29N	363 01W	3181	01 75 - 12 75	STAR	SA	T52135				
DETROIT	METRO-WAYNE CAP WRS	MI	94647	72537	42 14N	363 20W	3187	01 71 - 12 71	STAR	SA	T51772			
DETROIT	METRO-WAYNE CAP WRS	MI	94647	72537	42 14N	363 20W	3187	31 72 - 12 72	STAR	SA	T50049			
DETROIT	METRO-WAYNE CAP WRS	MI	94647	72537	42 14N	363 20W	3187	31 73 - 12 73	STAR	SA	T52026			
DETROIT	METRO-WAYNE CAP WRS	MI	94647	72537	42 14N	363 20W	3187	01 74 - 12 74	STAR	SA	T52442			
DETROIT	METRO-WAYNE CAP WRS	MI	94647	72537	42 14N	363 20W	3187	01 74 - 12 74	STAR	SA	T51021			
DETROIT	METRO-WAYNE CAP WRS	MI	94647	72537	42 14N	363 20W	3187	01 75 - 12 75	STAR	SA	T52135			
FLINT	BISHOP APT - WRS	MI	14626	72637	42 58N	363 44W	3235	01 60 - 12 64	STAR	SA	T50440			
FLINT	BISHOP APT - WRS	MI	14626	72637	42 58N	363 44W	3235	01 65 - 12 68	STAR	SA	T51872			
FLINT	BISHOP APT - WRS	MI	14626	72637	42 58N	363 44W	3235	01 65 - 12 75	STAR	SA	T52408			
FLINT	BISHOP APT - WRS	MI	14626	72637	42 58N	363 44W	3235	01 72 - 12 72	STAR	SA	T51772			
FLINT	BISHOP APT - WRS	MI	14626	72637	42 58N	363 44W	3235	01 73 - 12 73	STAR	SA	T50512			
FLINT	BISHOP APT - WRS	MI	14626	72637	42 58N	363 44W	3235	01 74 - 12 74	STAR	SA	T51021			
FLINT	BISHOP APT - WRS	MI	14626	72637	42 58N	363 44W	3235	01 75 - 12 75	STAR	SA	T52135			
GMIAW	AI SAUER AFB	MI	94626	42 21N	367 24W	3277	01 45 - 12 57	STAR	SA	T50828.3				
GMIAW	AI SAUER AFB	MI	94626	42 21N	367 24W	3277	01 45 - 12 70	STAR	SA	T50922				
LANSING	CAPITAL CITY APT - WRS	MI	14636	72538	42 47N	364 38W	288	01 60 - 12 73	STAR	A	T5016			
MUSKEGOM	MUSKEGOM COUNTY APT - WRS	MI	14640	72636	43 10N	366 14W	3182	01 67 - 12 71	STAR	SA	T51900			
SAGINAW	TRI-CITY APT CAR	MI	14645	43 32N	364 05W	3183	01 40 - 12 54	STAR	SA	T52080				
SAGINAW	TRI-CITY APT CAR	MI	14645	43 32N	364 05W	3203	01 46 - 12 54	STAR	SA	T52283.3				
SAGINAW	TRI-CITY APT CAR	MI	14645	43 32N	364 05W	3204	01 50 - 12 54	STAR	SA	T51736				
SAGINAW	TRI-CITY APT CAR	MI	14645	43 32N	364 05W	3204	01 50 - 12 54	STAR	SA	T52038				
TRAVERSE CITY	CHERRY CAP CAR	MI	14650	44 44N	369 35W	3182	01 74 - 12 74	STAR	MSA	T51290				
YPSILANTI	WILLOW RUN APT - WRS	MI	14653	42 14N	363 32W	3237	10 63 - 08 68	STAR	A	T5016				
YPSILANTI	WILLOW RUN APT - WRS	MI	14653	42 14N	363 32W	3237	10 63 - 08 68	STAR	SA	T52125.3				
ALEXANDRIA	MUNICIPAL APT CAR	PA	14610	49 52N	095 23W	0435	01 92 - 12 54	STAR	SA	T50803				
DULUTH	INTERNATIONAL APT - WRS	PA	14613	72744	46 50N	392 11W	0434	01 67 - 12 71	STAR	SA	T51408			
DULUTH	INTERNATIONAL APT - WRS	PA	14613	72744	46 50N	392 11W	0434	01 70 - 12 74	STAR	SA	T51860.3			
MINNEAPOLIS	INTERNATIONAL APT - WRS	PA	14622	72656	44 53N	393 13W	0262	31 58 - 12 72	STAR	MSA	T50087			
MINNEAPOLIS	INTERNATIONAL APT - WRS	PA	14622	72656	44 53N	393 13W	0262	31 60 - 12 64	STAR	PA	T50218			
MINNEAPOLIS	INTERNATIONAL APT - WRS	PA	14622	72656	44 53N	393 13W	0262	01 55 - 12 74	STAR	PA	T52351.3			
MINNEAPOLIS	INTERNATIONAL APT - WRS	PA	14622	72656	44 53N	393 13W	0262	01 57 - 12 71	STAR	PA	T51058			
BROCKPORT	MUNICIPAL APT - WRS	PA	14625	72644	43 56N	392 30W	0402	01 56 - 12 73	STAR	PA	T51085			
SILVER	EEESLER AFB	PA	13620	30 24N	366 55W	0008	01 50 - 12 64	STAR	PA	T50775				
SILVER	EEESLER AFB	PA	13620	30 24N	366 55W	0008	01 50 - 12 64	STAR	A	T50010				
COLUMBUS	AFB	PA	13625	33 38N	366 27W	3085	01 66 - 12 74	STAR	SA	T50475				
COLUMBUS	AFB	PA	13625	33 38N	366 27W	3086	01 56 - 12 70	STAR	SA	T50636				
GREENVILLE	AFB	PA	13630	72238	33 33N	366 00W	0042	11 55 - 10 60	STAR	SA	T51454			
JACKSON	THOMPSON MAP - WRS	PA	03840	72239	32 18N	360 05W	3110	01 55 - 12 64	STAR	A	T51281			
JACKSON	THOMPSON MAP - WRS	PA	03840	72239	32 18N	360 05W	3110	01 55 - 12 66	STAR	MSA	T51408			
JACKSON	THOMPSON MAP - WRS	PA	03840	72239	32 18N	360 05W	3110	01 55 - 12 66	STAR	SA	T51873			
JACKSON	THOMPSON MAP - WRS	PA	03840	72239	32 18N	360 05W	3110	01 66 - 12 70	STAR	SA	T52025			
JACKSON	THOMPSON MAP - WRS	PA	03840	72239	32 18N	360 05W	3110	01 70 - 12 70	STAR	SA	T52925			
JACKSON	HAWKINS FIELD - WRS	PA	13656	72235	32 20N	360 13W	3086	01 60 - 12 54	STAR	MSA	T51408			
JACKSON	HAWKINS FIELD - WRS	PA	13656	72235	32 20N	360 13W	3086	01 60 - 12 54	STAR	PA	T51287			
JACKSON	HAWKINS FIELD - WRS	PA	13656	72235	32 20N	360 13W	3086	01 60 - 12 54	STAR	PA	T51900			
MCLEOD	PIKE COUNTY CAR	PA	03819	31 15N	360 26W	0086	01 70 - 12 49	STAR	SA	T51036				
TERIDIAN	KEY FIELD - WRS	PA	13685	72234	32 20N	360 45W	0086	01 68 - 12 70	STAR	SA	T51295			
TERIDIAN	KEY FIELD - WRS	PA	13685	72234	32 20N	360 45W	0086	01 70 - 12 70	STAR	SA	T51295			
COLUMBIA	REGIONAL APT - WRS	PA	03844	72446	38 48N	362 13W	0272	01 73 - 12 73	STAR	PA	T50300			
COLUMBIA	MUNICIPAL APT - WRS	PA	13683	72446	38 56N	362 22W	0286	01 54 - 12 68	STAR	A	T51744			
KANSAS CITY	MUNICIPAL APT - WRS	PA	03847	72446	39 16N	364 32W	0315	01 50 - 12 74	STAR	PA	T52223			
KANSAS CITY	MUNICIPAL APT - WRS	PA	13686	72446	39 07N	364 36W	0241	01 54 - 12 54	STAR	A	T50682.3			
KANSAS CITY	MUNICIPAL APT - WRS	PA	13686	72446	39 07N	364 36W	0228	01 57 - 12 71	STAR	A	T51785			
KANSAS CITY	MUNICIPAL APT - WRS	PA	13686	72446	39 07N	364 36W	0228	01 58 - 08 72	STAR	SA	T50635			
KIRKSVILLE	CANNON MEMORIAL APT	PA	14626	72446	39 07N	364 36W	0228	01 58 - 12 68	STAR	SA	T51081			
SAINT LOUIS	LAMBERT FIELD - WRS	PA	13684	72434	38 45N	360 23W	0172	01 50 - 12 64	STAR	PA	T50284			
SAINT LOUIS	LAMBERT FIELD - WRS	PA	13684	72434	38 45N	360 23W	0172	01 64 - 12 58	STAR	SA	T511930.26			
SAINT LOUIS	LAMBERT FIELD - WRS	PA	13684	72434	38 45N	360 23W	0172	01 64 - 12 60	STAR	SA	T51036.2			
SAINT LOUIS	LAMBERT FIELD - WRS	PA	13684	72434	38 45N	360 23W	0172	01 58 - 12 72	STAR	SA	T50122			
SAINT LOUIS	LAMBERT FIELD - WRS	PA	13684	72434	38 45N	360 23W	0172	01 58 - 12 68	STAR	A	T51054			
SAINT LOUIS	LAMBERT FIELD - WRS	PA	13684	72434	38 45N	360 23W	0172	01 70 - 09 71	STAR	A	T51157			
SAINT LOUIS	LAMBERT FIELD - WRS	PA	13684	72434	38 45N	360 23W	0172	01 70 - 09 70	STAR	S	T511920			
SPRINGFIELD	MUNICIPAL APT - WRS	PA	13685	72440	37 14N	363 23W	0386	01 56 - 12 70	STAR	SA	T51082			
BILLINGS	LOGAN FIELD - WRS	MT	24033	72677	45 48N	108 32W	1092	01 57 - 12 71	STAR	SA	T51405			
SUTTE	SILVER BOW COUNTY APT CAR	MT	24135	72679	45 57N	112 30W	1680	01 58 - 12 50	STAR	SA	T50355			
CUSTER	CAR	MT	24040	46 07N	107 31W	3076	01 48 - 05 50	STAR	TA	T514527				
CUT BANK	MUNICIPAL APT CAR	MT	24137	45 38N	112 22W	1174	01 49 - 12 58	STAR	TA	T50298				

CITY	NAME - TYPE	ST	ST	LAT	LONG	ELEV	PERIOD 200300	PF	SUMMARY	SUM FEDS	LASTREPOD
GLASCOW	INTERNATIONAL APT -WRS	MT	34008	72766	48 13N	108 37W	0896	01 55 - 12 53	STAR	SA	71080-43
GLASCOW	INTERNATIONAL APT -WRS	MT	34008	72766	48 13N	108 37W	0896	01 57 - 12 71	STAR	SA	714527
HAZEL	CITY-COUNTY APT -WRS	MT	34012	72770	48 33N	108 46W	0786	01 57 - 12 71	STAR	SA	714627
HELENA	WRS	MT	24144	72772	48 38N	112 20W	1186	01 58 - 12 52	STAR	SA	713835
HELENA	WRS	MT	24144	72772	48 38N	112 20W	1186	01 59 - 12 72	STAR	SA	715236
KALISPELL	GLACIER PARK INL APT -WRS	MT	24146	72778	48 18N	114 16W	0906	01 50 - 12 52	STAR	SA	715061
KALISPELL	GLACIER PARK INL APT -WRS	MT	24146	72778	48 18N	114 16W	0906	01 53 - 12 72	STAR	SA	714723
LEWISTON	MUNICIPAL APT FMR	MT	24038	72782	47 33N	108 27W	1262	01 57 - 12 71	STAR	SA	714527
TILES CITY	MUNICIPAL APT FMR	MT	24037	72783	48 28N	105 52W	2802	01 57 - 12 71	STAR	SA	714125
MISSOULA	JOHNSON-SELL FIELD -WRS	MT	24153	72773	48 55N	114 03W	3980	01 57 - 12 71	STAR	SA	714627
LINCOLN	AFB	NE	14804	72551	40 51N	106 45W	3356	01 58 - 12 53	STAR	A	752081
NORTH PLATTE	LEE SIBRO FIELD -WRS	NE	24023	72562	41 08N	100 41W	2846	01 50 - 12 54	STAR	SA	714312
NORTH PLATTE	LEE SIBRO FIELD -WRS	NE	24023	72562	41 08N	100 41W	2846	01 58 - 12 73	STAR	SA	715189
SPRINGDALE	COPLEY FIELD -WRS	NE	14842	72562	41 08N	100 41W	2846	09 73 - 34 75	STAR	SA	752016-3
SPRINGDALE	COPLEY FIELD -WRS	NE	14842	72563	41 08N	105 54W	3304	01 54 - 12 54	STAR	A	751032
SPRINGDALE	COPLEY FIELD -WRS	NE	14842	72563	41 08N	105 54W	3304	08 67 - 12 73	STAR	A	751298
SPRINGDALE	COPLEY FIELD -WRS	NE	14842	72563	41 08N	105 54W	3304	08 67 - 12 73	STAR	A	752008
SPRINGDALE	COPLEY FIELD -WRS	NE	14842	72563	41 08N	105 54W	3304	01 68 - 12 73	STAR	A	701776
SPRINGDALE	COPLEY FIELD -WRS	NE	14842	72563	41 08N	105 54W	3304	01 68 - 12 73	STAR	A	751020
SCOTTSDALE	MUNICIPAL APT -WRS	NE	24028	72568	41 52N	103 36W	1204	01 57 - 12 71	STAR	SA	750663-3
SCOTTSDALE	MUNICIPAL APT -WRS	NE	24028	72568	41 52N	103 36W	1204	01 57 - 12 71	STAR	SA	714542
SCOTTSDALE	MUNICIPAL APT -WRS	NE	24028	72568	41 52N	103 36W	1204	01 58 - 12 72	STAR	SA	750296
CLARK	MUNICIPAL APT FMR	NV	84121	72562	40 30N	115 47W	1947	01 58 - 12 73	STAR	SA	751028
ELY	YELLOW FIELD -WRS	NV	23154	72466	38 17N	114 51W	1807	01 57 - 12 71	STAR	SA	713285
LAS VEGAS	MELLIS AFB	NV	23112	72466	38 19N	115 02W	2973	01 58 - 12 67	STAR	SA	715028
LAS VEGAS	McCARRAN INL APT -WRS	NV	23168	72366	38 05N	115 10W	0644	01 58 - 12 73	STAR	SA	750528-470
LAS VEGAS	McCARRAN INL APT -WRS	NV	23168	72366	38 05N	115 10W	0644	01 58 - 12 73	STAR	SA	750528-47F
LOVELOCK	DEDET APT FMR	NV	24172	72466	40 34W	118 33M	1180	01 58 - 12 73	STAR	SA	751028
RENO	STEREO AFB	NV	23118	72466	39 40N	118 47W	1931	01 58 - 12 65	STAR	SA	715028
RENO	INTERNATIONAL APT -WRS	NV	23185	72466	39 30N	118 47W	1343	01 58 - 12 64	STAR	A	752240
RENO	INTERNATIONAL APT -WRS	NV	23185	72466	39 30N	118 47W	1343	01 58 - 12 60	STAR	SA	750878
WINNEMUCCA	MUNICIPAL APT -WRS	NV	24126	72563	40 54N	117 48W	3322	01 58 - 12 73	STAR	SA	751028
CONCORD	MUNICIPAL APT -WRS	NM	14746	72605	43 12N	071 30W	0104	01 50 - 12 64	STAR	A	715140-102
CONCORD	MUNICIPAL APT -WRS	NM	14746	72605	43 12N	071 30W	0104	01 50 - 12 64	STAR	SA	750303
CONCORD	MUNICIPAL APT -WRS	NM	14746	72605	43 12N	071 30W	0105	01 50 - 12 70	STAR	SA	712928
POSTS/ROUTE	PEASE AFB	NM	04743	72603	43 03N	070 49W	0038	01 58 - 12 58	STAR	SA	712926
ATLANTIC CITY	WRS	NJ	93730	72407	38 27N	074 35W	0020	01 64 - 12 54	STAR	A	752113
ATLANTIC CITY	WRS	NJ	93730	72407	38 27N	074 35W	0020	01 64 - 12 54	STAR	SA	713831
ATLANTIC CITY	WRS	NJ	93730	72407	38 27N	074 35W	0020	01 66 - 12 72	STAR	SA	714622
ATLANTIC CITY	WRS	NJ	93730	72407	38 27N	074 35W	0020	01 70 - 12 74	STAR	A	752039
BELMONT	ASC	NJ	14738	72407	40 11N	074 04W	0026	01 58 - 12 58	STAR	SA	713381
LAKESHORE	WRS	NJ	14780	72408	40 32N	074 18W	0036	01 68 - 12 72	STAR	SA	714630
NEWARK	WRS	NJ	14734	72502	40 42N	074 10W	0008	01 55 - 12 64	STAR	SA	712872
NEWARK	WRS	NJ	14734	72502	40 42N	074 10W	0008	01 60 - 12 64	STAR	SA	714447-47L
NEWARK	WRS	NJ	14734	72502	40 42N	074 10W	0008	01 60 - 12 64	STAR	SA	714447-47I
NEWARK	WRS	NJ	14734	72502	40 42N	074 10W	0008	01 60 - 12 64	STAR	SA	714447-47K
NEWARK	WRS	NJ	14734	72502	40 42N	074 10W	0008	01 66 - 12 70	STAR	SA	712910
NEWARK	WRS	NJ	14734	72502	40 42N	074 10W	0008	01 70 - 12 70	STAR	SA	712692
TEREBORO	SAM	NJ	94741	72502	40 51N	074 03W	0002	01 52 - 12 56	STAR	SA	750200
WEIGHTSTOWN	ACQUIRE AFB	NJ	14706	72503	40 00N	074 36W	0049	01 56 - 12 70	STAR	SA	715100
ALBUQUERQUE	SUN-LIRTLAND INL APT -WRS	NM	23050	72365	35 03N	108 37W	1818	01 58 - 12 64	STAR	SA	714164
ALBUQUERQUE	SUN-LIRTLAND INL APT -WRS	NM	23050	72365	35 03N	108 37W	1818	01 75 - 12 75	STAR	SA	752113
FARMINGTON	MUNICIPAL APT CAR	NM	23080	72365	36 49N	108 14W	1677	01 54 - 12 50	STAR	SA	713028
FARMINGTON	MUNICIPAL APT FMR	NM	23080	72365	36 49N	108 14W	1677	09 63 - 34 68	STAR	SA	712180
CALIFORNIA	SENATOR CLARKE FIELD SAME	NM	23081	72365	32 41N	103 12W	1117	01 46 - 12 46	STAR	SA	752176
HOBBS	LEA COUNTY APT CAR	NM	23034	72365	32 41N	103 12W	1117	01 46 - 12 54	STAR	SA	752338
HOBBS	LEA COUNTY APT CAR	NM	23034	72365	32 41N	103 12W	1117	01 46 - 12 54	STAR	SA	714040
LAS CRUCES	WHITE SANDS AF	NM	93034	72365	32 41N	103 12W	1117	01 51 - 12 55	STAR	SA	752338
SANTA FE	CAR	NM	23044	72365	35 37N	106 39W	1925	01 50 - 12 54	STAR	SA	752246
ZUMI	INTERMEDIATE FIELD FSS	NM	93044	72365	35 08N	106 48W	1985	01 57 - 12 71	STAR	SA	714358
ALBANY	MUNICIPAL APT -WRS	NY	14735	72516	42 49N	073 46W	0088	01 50 - 12 64	STAR	SA	714813
ALBANY	MUNICIPAL APT -WRS	NY	14735	72516	42 49N	073 46W	0088	01 66 - 12 70	STAR	SA	712910
ALBANY	MUNICIPAL APT -WRS	NY	14735	72516	42 49N	073 46W	0088	01 57 - 12 71	STAR	SA	714384-115G
ALBANY	MUNICIPAL APT -WRS	NY	14735	72516	42 49N	073 46W	0088	01 57 - 12 71	STAR	SA	714384-115G
ALBANY	MUNICIPAL APT -WRS	NY	14735	72516	42 49N	073 46W	0088	01 57 - 12 71	STAR	SA	714384-115G
ALBANY	MUNICIPAL APT -WRS	NY	14735	72516	42 49N	073 46W	0088	01 57 - 12 71	STAR	SA	714384-115H
ALBANY	MUNICIPAL APT -WRS	NY	14735	72516	42 49N	073 46W	0088	01 57 - 12 71	STAR	SA	714384-115I
SINGHAMONTON	SROOPE COUNTY APT -WRS	NY	04725	72515	42 13N	075 58W	0463	01 50 - 12 64	STAR	SA	714640
SINGHAMONTON	SROOPE COUNTY APT -WRS	NY	04725	72515	42 13N	075 58W	0463	01 54 - 12 54	STAR	SA	751772
SINGHAMONTON	SROOPE COUNTY APT -WRS	NY	04725	72515	42 13N	075 58W	0463	01 54 - 12 54	STAR	SA	750408
BIRCHMONTON	TRI-CITIES APT -WRS	NY	14738	72516	42 55N	076 08W	0254	01 50 - 12 50	STAR	SA	750408
SUFFALO	3TR SUFFALO INL APT -WRS	NY	14733	72528	42 56N	076 44W	0218	01 54 - 12 73	STAR	SA	750366
SUFFALO	3TR SUFFALO INL APT -WRS	NY	14733	72528	42 56N	076 44W	0218	01 57 - 12 71	STAR	SA	751772
SUFFALO	3TR SUFFALO INL APT -WRS	NY	14733	72528	42 56N	076 44W	0218	01 57 - 12 71	STAR	SA	714452
SUFFALO	3TR BUFFALO INL APT -WRS	NY	14733	72528	42 56N	076 44W	0218	01 57 - 12 73	STAR	SA	750847-3
ELMIRA	CHEMUNG COUNTY APT CAR	NY	14748	72516	42 13N	076 54W	0289	01 50 - 12 54	STAR	SA	751195-3
GLENS FALLS	LAGER COUNTY APT CAR	NY	14750	72516	43 21N	077 37W	0104	01 50 - 12 54	STAR	SA	751195-3
NEW YORK	LA GUARDIA APT -WRS	NY	14732	72503	40 46N	073 52W	0015	01 51 - 12 50	STAR	A	714022





CITY	NAME - TYPE	ST	S	E	LAT	LONG	ELEV	PERIOD OF RECORD	TYPE	SUM- FREQ	SUM- TICKS/RECORDS
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13738	72408	39 53N	775 15W	2000	31 60 - 12 54	STAR	SA	T14523.471
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 50 - 12 54	STAR	SA	T14523.472
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 50 - 12 54	STAR	SA	T14523.479
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 50 - 12 54	STAR	A	T13167
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 50 - 12 54	STAR	A	T14535.47H
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 50 - 12 54	STAR	A	T14542
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 70 - 12 70	STAR	A	T14252
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 71 - 12 71	STAR	A	T14252
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 71 - 12 71	STAR	SA	T01772
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 72 - 12 72	STAR	A	T50884
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 72 - 12 72	STAR	A	T01772
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 73 - 12 73	STAR	SA	T50883
PHILADELPHIA	INTERNATIONAL ART WARS	PA	13739	72408	39 53N	775 15W	2000	31 74 - 12 74	STAR	A	T52217
PHILADELPHIA	MID STATE ART CRR	PA	14781	72512	40 53R	775 25W	2586	01 50 - 12 54	STAR	SA	T14015
PITTSBURGH	ALLEGHENY COUNTY ART	PA	14782	72520	40 53R	774 56W	0386	01 74 - 12 75	STAR	SA	T52345.3
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 63 - 12 59	STAR	A	T14407
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 64 - 12 73	STAR	SA	T15347.3
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 64 - 12 80	STAR	SA	T12088
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 64 - 12 80	STAR	A	T14407
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 67 - 12 67	STAR	A	T14407
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 68 - 12 68	STAR	A	T14407
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 68 - 12 73	STAR	SA	T15347.3
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 68 - 12 73	STAR	A	T50880
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 70 - 12 70	STAR	PA	T13680
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 70 - 12 74	STAR	SA	T15675.3
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 71 - 12 71	STAR	PA	T13680
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 72 - 12 72	STAR	A	T01772
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 72 - 12 72	STAR	A	T01772
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 72 - 12 73	STAR	PA	T50880
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 73 - 12 73	STAR	A	T50880
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 73 - 12 73	STAR	SA	T15347.3
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 74 - 12 74	STAR	SA	T15675.3
PITTSBURGH	GTR PITTSBURGH ART WARS	PA	94623	72520	40 53R	0380 13W	0373	01 74 - 12 74	STAR	SA	T51038.3
READING	GEN SMARTZ FLD FPR RAR	PA	14752	72510	40 23R	075 58W	0086	01 48 - 12 49	STAR	SA	T13285
READING	GEN SMARTZ FLD FPR RAR	PA	14752	72510	40 23R	075 58W	0086	01 49 - 12 49	STAR	SA	T13285
WILKES-BARRE	WRS SCRANTON	PA	14777	72513	41 20R	075 44W	0262	01 60 - 12 64	STAR	SA	T14643
WILKES-BARRE	WRS SCRANTON	PA	14777	72513	41 20R	075 44W	0262	01 64 - 12 73	STAR	SA	T15347.3
WILKES-BARRE	WRS SCRANTON	PA	14777	72513	41 20R	075 44W	0262	01 69 - 12 73	STAR	SA	T15347.3
WILKES-BARRE	WRS SCRANTON	PA	14777	72513	41 20R	075 44W	0262	01 71 - 12 75	STAR	PA	T51040
WILKES-BARRE	WRS SCRANTON	PA	14777	72513	41 20R	075 44W	0262	01 73 - 12 73	STAR	SA	T15347.3
WILLIAMSPORT	LYCINGOM COUNTY ART WARS	PA	14778	72514	41 15M	076 55W	0160	01 54 - 12 73	STAR	SA	T15347.3
WILLIAMSPORT	LYCINGOM COUNTY ART WARS	PA	14778	72514	41 15M	076 55W	0160	01 59 - 12 73	STAR	SA	T15347.3
WILLOW GROVE	NRS	PA	14783	72514	40 12M	075 09W	0102	01 70 - 12 70	STAR	A	T14252
WILLOW GROVE	NRS	PA	14783	72514	40 12M	075 09W	0102	01 71 - 12 71	STAR	A	T14252
WILLOW GROVE	NRS	PA	14783	72514	40 12M	075 09W	0102	01 74 - 12 74	STAR	SA	T51036.3
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	01 50 - 12 64	STAR	SA	T14116
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	01 54 - 12 73	STAR	PA	T50379
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	01 56 - 12 72	STAR	SA	T14793
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	01 72 - 12 72	STAR	SA	T50655
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	01 72 - 12 72	STAR	PA	T13602
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	06 72 - 06 72	STAR	PA	T50726
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	01 74 - 12 74	STAR	A	T52449
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	01 74 - 12 74	STAR	SA	T51176.3
PROVIDENCE	T F GREEN ART WARS	RI	14785	72507	41 44R	071 26W	0018	05 74 - 10 74	STAR	A	T52448.32
POCONO	POCONO COUNTY ART CRR	SC	93846	72208	34 30R	062 43W	0233	01 54 - 12 58	STAR	SA	T13686
CHARLESTON	MUNICIPAL ART WARS	SC	13680	72208	32 54R	060 02W	0018	01 50 - 12 54	STAR	SA	T12919
CHARLESTON	MUNICIPAL ART WARS	SC	13680	72208	32 54R	060 02W	0018	01 56 - 12 72	STAR	PA	T14415
CHARLESTON	MUNICIPAL ART WARS	SC	13680	72208	32 54R	060 02W	0018	01 70 - 12 70	STAR	SA	T12919
COLUMBIA	METROPOLITAN ART WARS	SC	13683	72210	33 57R	061 07W	0076	01 57 - 12 68	STAR	SA	T14140
COLUMBIA	METROPOLITAN ART WARS	SC	13683	72210	33 57R	061 07W	0076	01 67 - 12 71	STAR	SA	T14140
COLUMBIA	METROPOLITAN ART WARS	SC	13683	72210	33 57R	061 07W	0076	01 69 - 12 71	STAR	SA	T14140
COLUMBIA	METROPOLITAN ART WARS	SC	13683	72210	33 57R	061 07W	0086	01 70 - 12 74	STAR	SA	T51979
FLORENCE	GILBERT FIELD ART WARS	SC	13683	72210	33 57R	061 07W	0086	08 72 - 07 73	STAR	SA	T15164
GREENVILLE	GREEN-SPORT ART WARS	SC	03870	72212	34 54R	062 43W	0046	01 50 - 12 54	STAR	SA	T50268
GREENVILLE	GREEN-SPORT ART WARS	SC	03870	72212	34 54R	062 43W	0046	01 53 - 12 57	STAR	SA	T12919
GREENVILLE	GREEN-SPORT ART WARS	SC	03870	72212	34 54R	062 43W	0046	01 58 - 12 72	STAR	SA	T14487
GREENVILLE	GREEN-SPORT ART WARS	SC	03870	72212	34 54R	062 43W	0046	01 66 - 12 72	STAR	A	T14442
GREENVILLE	GREEN-SPORT ART WARS	SC	03870	72212	34 54R	062 43W	0046	01 70 - 12 70	STAR	SA	T12919
SPARTANBURG	METROPOL ART WARS	SC	93804	72213	34 55R	061 57W	0240	01 57 - 12 51	STAR	SA	T14413
PIERRE	MUNICIPAL ART FIS	SD	24025	72316	44 23R	100 17W	0528	01 67 - 12 71	STAR	PA	T14316
RAPID CITY	MUNICIPAL ART WARS	SD	24080	72662	44 03M	103 04W	0866	01 57 - 12 71	STAR	PA	T14122
SIOUX FALLS	FISH FIELD WARS	SD	14944	72651	43 34R	066 44W	0435	01 56 - 12 72	STAR	PA	T14676
SIOUX FALLS	FISH FIELD WARS	SD	14944	72651	43 34R	066 44W	0435	01 74 - 12 74	STAR	A	T52157.3
BRISTOL	TRI-CITY ART WARS	TN	13877	72316	36 29R	062 24W	0475	01 50 - 12 54	STAR	SA	T51955.3
BRISTOL	TRI-CITY ART WARS	TN	13877	72316	36 29R	062 24W	0475	01 56 - 12 70	STAR	SA	T13054
CHATTANOOGA	JEWELL FIELD WARS	TN	13877	72316	36 29R	062 24W	0475	01 74 - 12 74	STAR	A	T51543
CHATTANOOGA	JEWELL FIELD WARS	TN	13882	72324	35 32R	065 12W	0210	01 50 - 12 54	STAR	SA	T50242.474
CHATTANOOGA	JEWELL FIELD WARS	TN	13882	72324	35 32R	065 12W	0210	01 50 - 12 54	STAR	SA	T51955.3
CHATTANOOGA	JEWELL FIELD WARS	TN	13882	72324	35 32R	065 12W	0210	01 57 - 12 71	STAR	SA	T14372
CHATTANOOGA	JEWELL FIELD WARS	TN	13882	72324	35 32R	065 12W	0210	01 58 - 12 73	STAR	SA	T50621

CITY	NAME - TYPE	ST	#	LAT	LONG	ELEV	SERIAL#		TYPE	SUMM	FREQ	TRX/REMARKS
							REC#30	REC#30				
CHATTANOOGA	LOWELL FIELD WARS	TN	13862	72324	35 22N	865 12W	0210	01 70 - 12 70	STAR	SA	713252	
JACKSON	MICELL	TN	13861	72325	35 38N	865 55W	0129	01 49 - 12 54	STAR	SA	713248	
KNOXVILLE	MONICE TYSN ART WARS	TN	13861	72326	35 49N	863 58W	0287	01 56 - 12 70	STAR	SA	713254	
KNOXVILLE	MONICE TYSN ART WARS	TN	13861	72326	35 49N	863 59W	0288	01 56 - 12 70	STAR	SA	713261	
MEMPHIS	INTERNATIONAL ART WARS	TN	13863	72324	35 33N	866 58W	0286	01 57 - 12 71	STAR	SA	713479	
NASHVILLE	SERRY FIELD WARS WARS	TN	13867	72327	36 37N	866 41W	0177	01 50 - 12 54	STAR	A	714424-474	
NASHVILLE	SERRY FIELD WARS WARS	TN	13867	72327	36 37N	866 41W	0183	01 56 - 12 70	STAR	SA	712881	
NASHVILLE	SERRY FIELD WARS WARS	TN	13867	72327	36 37N	866 41W	0184	01 70 - 12 70	STAR	A	712751	
NASHVILLE	SERRY FIELD WARS WARS	TN	13867	72327	36 37N	866 41W	0184	01 73 - 12 73	STAR	SA	712826	
ABILENE	MUNICIPAL ART WARS	TX	13863	72286	32 26N	866 41W	0537	01 67 - 12 71	STAR	SA	701772	
ABILENE	MUNICIPAL ART WARS	TX	13862	72286	32 26N	866 41W	0537	01 72 - 12 73	STAR	SA	703008	
AMARILLO	ENGLISH FLD WARS WARS	TX	23047	72383	35 14N	101 42W	1088	01 59 - 12 54	STAR	SA	703080	
AUSTIN	MULLER FLD WARS WARS	TX	13858	72254	30 18N	867 42W	0189	01 57 - 12 71	STAR	A	714264	
AUSTIN	MULLER FLD WARS WARS	TX	13858	72254	30 18N	867 42W	0189	01 58 - 12 70	STAR	SA	711101	
BEEVILLE	CHASE FIELD WARS	TX	13825	72256	28 22N	867 40W	0080	01 65 - 12 56	STAR	SA	710663	
BEEVILLE	CHASE FIELD WARS	TX	13825	72256	28 22N	867 40W	0080	01 66 - 12 70	STAR	A	713121	
CORPUS CHRISTI	WARS	TX	12826	72261	27 41N	867 17W	0006	01 65 - 12 58	STAR	SA	712761	
COTulla	MUNICIPAL ART CAR	TX	12847	72266	28 24N	866 13W	0141	01 50 - 12 54	STAR	SA	710863	
DALLAS	LOVE FIELD WARS	TX	13840	72298	32 31N	866 51W	0158	01 50 - 12 64	STAR	SA	713080	
DALLAS	LOVE FIELD WARS	TX	13840	72298	32 31N	866 51W	0158	01 57 - 12 71	STAR	A	714181	
DALLAS	LOVE FIELD WARS	TX	13840	72298	32 31N	866 51W	0158	01 58 - 12 72	STAR	A	714466	
DELL RIO	LOUGHDRY AFB	TX	22001	72281	29 22N	100 47W	0237	01 65 - 12 58	STAR	SA	712781	
EL PASO	INTERNATIONAL ART WARS	TX	23044	72270	31 46N	108 24W	1200	01 50 - 12 64	STAR	SA	714962	
EL PASO	INTERNATIONAL ART WARS	TX	23044	72270	31 46N	108 24W	1198	01 52 - 12 72	STAR	SA	701772	
FORT WORTH	GREATER SW IML ART WARS	TX	23027	72254	32 50N	867 03W	0179	01 57 - 12 71	STAR	SA	712415	
FORT WORTH	GREATER SW IML ART WARS	TX	23027	72256	32 50N	867 03W	0179	01 57 - 12 71	STAR	SA	714024	
FORT WORTH	GREATER SW IML ART WARS	TX	23027	72256	32 50N	867 03W	0179	01 58 - 12 74	STAR	SA	712415	
FORT WORTH	MECHANIC FLD WARS	TX	13861	72243	32 46N	867 21W	0215	01 46 - 12 92	STAR	SA	712383-3	
GALVESTON	SCHOLLES FIELD WARS	TX	12823	72243	28 18N	866 51W	0008	01 54 - 12 80	STAR	SA	714432	
GALVESTON	SCHOLLES FIELD WARS	TX	12823	72243	28 18N	866 51W	0008	01 56 - 12 82	STAR	A	714356	
HOUSTON	ELLINGTON AFB	TX	12806	72243	28 37N	866 10W	0012	01 68 - 12 70	STAR	SA	710855-3	
HOUSTON	ELLINGTON AFB	TX	12806	72243	28 37N	866 10W	0012	01 68 - 12 80	STAR	SA	712243	
HOUSTON	HOBBY IML ART WARS	TX	12818	72243	28 38N	866 17W	0018	01 64 - 12 68	STAR	SA	713674	
HOUSTON	HOBBY IML ART WARS	TX	12818	72243	28 38N	866 17W	0018	01 65 - 12 87	STAR	SA	713425	
HOUSTON	INTERCONTINENTAL ART WARS	TX	12840	72243	28 56N	865 22W	0033	08 58 - 07 72	STAR	A	714181	
HOUSTON	INTERCONTINENTAL ART WARS	TX	12840	72243	28 56N	865 22W	0033	08 59 - 07 70	STAR	A	714068	
HOUSTON	INTERCONTINENTAL ART WARS	TX	12840	72243	28 56N	865 22W	0033	08 60 - 12 71	STAR	SA	713813	
HOUSTON	INTERCONTINENTAL ART WARS	TX	12840	72243	28 56N	865 22W	0033	08 60 - 12 71	STAR	SA	710172	
HOUSTON	INTERCONTINENTAL ART WARS	TX	12860	72243	28 56N	865 22W	0033	08 71 - 12 73	STAR	A	713074	
HOUSTON	INTERCONTINENTAL ART WARS	TX	12860	72243	28 56N	865 22W	0033	08 72 - 12 72	STAR	A	701772	
HOUSTON	INTERCONTINENTAL ART WARS	TX	12860	72243	28 56N	865 22W	0033	08 72 - 07 73	STAR	A	714468	
LAREDO	AFB	TX	12907	72252	27 32N	866 26W	0154	04 65 - 03 70	STAR	SA	712761	
LUKER	ANGELINA COUNTY ART FSS	TX	93867	72269	31 14N	864 49W	0088	01 67 - 12 71	STAR	A	714443	
MIDLAND	MID-OKESSA RCL ATL WARS	TX	23023	72269	31 16N	102 12W	0275	01 50 - 12 64	STAR	SA	713031	
MIDLAND	MID-OKESSA RCL ATL WARS	TX	23023	72265	31 16N	102 12W	0275	01 52 - 12 71	STAR	SA	701772	
PORt ARTHUR	JEFFERSON COUNTY ART WARS	TX	12817	72241	29 57N	864 01W	0009	01 67 - 12 71	STAR	SA	701772, 141	
SAN ANGELO	MATHEWS FIELD WARS	TX	23024	72263	31 22N	100 30W	0265	01 50 - 12 64	STAR	SA	713831	
SAN ANTONIO	INTERNATIONAL ART WARS	TX	12821	72253	29 32N	866 26W	0243	01 50 - 12 64	STAR	SA	713831	
TYLER	POUND'S FIELD CAR	TX	13872	72252	32 22N	865 24W	0173	01 50 - 12 54	STAR	SA	712127	
VICTORIA	FOSTER AFB	TX	12812	72255	28 51N	866 55W	0031	01 55 - 12 74	STAR	SA	712254	
WACO	MUNICIPAL ART WARS	TX	13856	72296	31 37N	867 13W	0155	01 68 - 12 73	STAR	SA	711101	
BRYCE CANYON	CAR	UT	23150	72246	37 42N	112 08W	2117	01 49 - 12 54	STAR	SA	713028	
DELTA	MUNICIPAL ART CAR	UT	23162	72470	39 23N	112 31W	1452	01 50 - 12 54	STAR	SA	712781	
HARRISVILLE	CAR	UT	23170	72473	38 25N	110 42W	1380	01 49 - 12 54	STAR	SA	713029	
MILFORD	MUNICIPAL ART CAR	UT	23176	72475	38 25N	110 31W	1934	07 47 - 12 51	STAR	SA	711121	
OGDEN	MILL AFB	UT	24101	72575	41 07N	111 58W	1496	01 65 - 12 58	STAR	SA	712908	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1286	01 48 - 12 48	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1286	01 48 - 12 49	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1286	01 50 - 12 50	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1286	01 51 - 12 51	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1286	01 52 - 12 52	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1286	01 53 - 12 52	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 54 - 12 54	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 55 - 12 55	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 56 - 12 56	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 57 - 12 57	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 58 - 12 58	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 59 - 12 59	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 60 - 12 50	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 61 - 12 51	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 62 - 12 52	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 63 - 12 53	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 64 - 12 54	STAR	A	712656	
SALT LAKE CITY	INTERNATIONAL ART WARS	UT	24127	72572	40 46N	111 58W	1287	01 65 - 12 55	STAR	A	712749	
BURLINGTON	INTERNATIONAL ART WARS	VT	14742	72617	44 26N	073 08W	0108	01 65 - 12 68	STAR	SA	712178	
BURLINGTON	INTERNATIONAL ART WARS	VT	14742	72617	44 26N	073 08W	0104	01 70 - 12 74	STAR	SA	712031-3	
BURLINGTON	INTERNATIONAL ART WARS	VT	14742	72617	44 26N	073 08W	0104	01 70 - 12 74	STAR	SA	715370	
CARLISLE	MUNICIPAL ART CAR	VA	13726	72601	38 34N	378 08W	0135	01 56 - 12 50	STAR	SA	710070	
CEDARVILLE	CAR	VA	13722	72601	38 34N	378 08W	0135	01 56 - 12 50	STAR	SA	710070	
LYNCHBURG	MUNICIPAL ART WARS	VA	13733	72410	37 20N	379 13W	3296	01 59 - 12 73	STAR	SA	710447	
NORFOLK	REGIONAL ART WARS	VA	13737	72308	36 54N	378 12W	0013	01 55 - 12 54	STAR	SA	714008	
NORFOLK	REGIONAL ART WARS	VA	13737	72308	36 54N	378 12W	0013	01 57 - 12 73	STAR	SA	711703	
NORFOLK	WAS	VA	13750	72617	38 57N	376 17W	301C	12 58 - 12 71	STAR	SA	712560	
PULASKI	NEW RIVER ART CAR	VA	13668	72550	37 05N	370 47W	0088	01 50 - 12 54	STAR	SA	711955	
QUANTICO	TCRS	VA	13773	72617	38 30N	377 18W	3004	01 55 - 12 50	STAR	SA	714427	
QUANTICO	TCRS	VA	13773	72617	38 30N	377 18W	3004	05 72 - 35 73	STAR	SA		

CITY	NAME - TYPE	ST	SEC	WD	ST	4	5	LAT	LONG	ELEV	PERIOD OF RECORD	SUMMARY	SUM	FED TAXES DUE
RICHMOND	3700 FIELD WOAS	VA	13740	72401	37	30N	077	20W	0054	01 54 - 12 73	STAR	SA	TS0623	
RICHMOND	3700 FIELD WOAS	VA	13740	72401	37	30N	077	20W	0055	01 54 - 12 71	STAR	SA	TS1772	
RICHMOND	3700 FIELD WOAS	VA	13740	72401	37	30N	077	20W	0056	01 52 - 12 72	STAR	SA	TS14226	
RICHMOND	3700 FIELD WOAS	VA	13740	72401	37	30N	077	20W	0054	01 54 - 12 74	STAR	SA	TS0803.3	
ROANOKE	DOORUM FIELD MAP WOAS	VA	13741	72411	37	19N	077	56W	0054	01 58 - 12 72	STAR	SA	TS1456	
WALLOPS ISLAND	1-80	VA	23738	72402	37	51N	077	25W	0004	01 57 - 12 72	STAR	SA	TS14520	
WALLOPS ISLAND	1-80	VA	23738	72402	37	51N	077	25W	0004	01 58 - 12 73	STAR	SA	TS14553	
BELLINGHAM	MUNICIPAL APT CAR	WA	24217		46	46N	122	32W	0047	01 46 - 12 58	STAR	SA	TS0951	
BELLINGHAM	MUNICIPAL APT CAR	WA	24217		46	46N	122	32W	0048	01 56 - 12 58	STAR	SA	TS11112	
DALLESPORT		WA	24218		49	37N	121	29W	0072	01 54 - 12 54	STAR	SA	TS2208	
ELLENBURG	CAR	WA	24220		47	02N	120	31W	0527	01 50 - 12 54	STAR	SA	TS14578	
EVERETT	PRINE FIELD AFB	WA	24141		47	18N	119	32W	0387	01 50 - 12 54	STAR	SA	TS14578	
HOQUAM	SOLIERMAN APT CAR	WA	24203		49	58N	123	56W	0008	01 53 - 12 67	STAR	SA	TS14578	
HOSES LAKE	LARSON AFB	WA	24110		47	11N	119	20W	0361	01 51 - 12 65	STAR	SA	TS14578	
OLYTHER	-WOS	WA	24227	72702	46	58N	123	44W	0066	01 50 - 12 54	STAR	SA	TS14578	
PORT ANGELES	WOS	WA	24228	72401	48	08N	123	24W	0009	01 46 - 12 53	STAR	SA	TS14578	
SEATTLE	SEA-TAC IHL APT WOAS	WA	24233	72703	47	27N	122	18W	0137	01 48 - 12 53	STAR	SA	TS14578	
SEATTLE	SEA-TAC IHL APT WOAS	WA	24233	72703	47	27N	122	18W	0137	01 48 - 12 71	STAR	SA	TS14578	
SPokane	BOEING FIELD MAP WOAS	WA	24234		47	32N	122	18W	0010	01 60 - 12 64	STAR	SA	TS14578	
TACOMA	GEIGER FIELD IHL APT WOAS	WA	24157	72785	47	38N	117	32W	0721	01 67 - 12 71	STAR	SA	TS22265	
TOLEDO	PECHORD AFB	WA	24207	72405	47	08N	122	28W	0068	01 44 - 12 70	STAR	SA	TS14578	
WALLA WALLA	CIRBLOCK APT CAR	WA	24241		46	20N	122	48W	0109	01 50 - 12 54	STAR	SA	TS14578	
WANDEBET ISLAND	WOS	WA	24160		46	38N	122	17W	0363	01 50 - 12 54	STAR	SA	TS14578	
WEST SPA	MUNICIPAL APT WOAS	WA	24236		46	21N	122	30W	0010	01 57 - 12 71	STAR	SA	TS14578	
CHARLESTON	CAROLINA APT WOAS	WV	13886	72414	38	22N	081	36W	0301	01 58 - 12 73	STAR	SA	TS0556.3	
HUNTINGTON	TRI-STATE WOAS	WV	03860	72425	38	22N	082	33W	0258	01 67 - 12 71	STAR	SA	TS13828	
HUNTINGTON	TRI-STATE APT WOAS	WV	03860	72425	38	22N	082	33W	0256	01 70 - 12 74	STAR	SA	TS15675.3	
HUNTINGTON	TRI-STATE APT WOAS	WV	03860	72425	38	22N	082	33W	0256	01 74 - 12 74	STAR	SA	TS15675.3	
HUNTINGTON	TRI-STATE APT WOAS	WV	03860	72425	38	22N	082	33W	0256	01 75 - 12 75	STAR	SA	TS2409.3	
HUNTINGTON	WHEELING APT CAR	WV	23818	72425	38	25N	082	30W	0173	01 50 - 12 54	STAR	SA	TS1898	
MARTINSBURG	MUNICIPAL APT CAR	WV	13734		39	24N	077	50W	0166	01 60 - 12 54	STAR	SA	TS0853	
MORGANTOWN	MUNICIPAL APT CAR	WV	13736		39	38N	078	54W	0380	01 50 - 12 54	STAR	SA	TS0856	
PARKERSBURG	WOS	WV	13867		39	58N	081	34W	0205	01 50 - 12 54	STAR	SA	TS0856	
CAU CLAIRE	MUNICIPAL APT FSS	WI	14081		44	52N	081	29W	0273	01 68 - 12 73	STAR	SA	TS0646	
GREEN BAY	AUSTIN STRAUDEL APT WOAS	WI	14088	72845	44	28N	088	20W	0212	01 64 - 12 73	STAR	SA	TS15127	
GREEN BAY	AUSTIN STRAUDEL APT WOAS	WI	14088	72845	44	28N	088	20W	0212	01 67 - 12 71	STAR	SA	TS14028	
GREEN BAY	AUSTIN STRAUDEL APT WOAS	WI	14088	72845	44	28N	088	20W	0212	01 68 - 12 73	STAR	SA	TS0644	
LA CROSSE	MUNICIPAL APT WOAS	WI	14020	72543	43	52N	081	15E	0201	01 48 - 12 53	STAR	SA	TS15137	
LA CROSSE	MUNICIPAL APT WOAS	WI	14020	72543	43	52N	081	15E	0201	01 50 - 12 54	STAR	SA	TS17722	
MAISISON	TRUX FIELD WOAS	WI	14037	72541	43	52N	081	15E	0201	01 67 - 12 71	STAR	SA	TS14026	
MAISISON	TRUX FIELD WOAS	WI	14037	72641	43	08N	089	20W	0265	01 54 - 12 73	STAR	SA	TS15127	
MAISISON	TRUX FIELD WOAS	WI	14037	72641	43	08N	089	20W	0265	01 67 - 12 71	STAR	SA	TS13390	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14037	72641	43	08N	089	20W	0262	01 73 - 12 73	STAR	SA	TS17722	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14038	72640	42	57N	087	54W	0215	01 50 - 12 64	STAR	SA	TS06256	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14038	72640	42	57N	087	54W	0215	01 64 - 12 73	STAR	SA	TS15127	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14039	72640	42	57N	087	54W	0215	01 56 - 12 70	STAR	SA	TS13124	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14039	72640	42	57N	087	54W	0211	01 67 - 12 71	STAR	SA	TS14026	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14039	72640	42	57N	087	54W	0211	01 58 - 12 72	STAR	SA	TS14462	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14039	72640	42	57N	087	54W	0211	01 70 - 12 70	STAR	SA	TS11873	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14039	72640	42	57N	087	54W	0205	01 73 - 12 73	STAR	SA	TS15127	
MILWAUKEE	MITCHELL FIELD WOAS	WI	14039	72640	42	57N	087	54W	0205	01 74 - 12 74	STAR	SA	TS0872	
MILWAUKEE	L J TIPPMAN APT CAR	WI	94060		43	07N	088	02W	0227	01 68 - 12 72	STAR	SA	TS2042	
CASPER	AIR TERMINAL WOAS	WY	24088	72560	42	55N	108	28W	1622	01 66 - 12 73	STAR	SA	TS2227.3	
CASPER	AIR TERMINAL WOAS	WY	24088	72560	42	55N	108	28W	1622	01 57 - 12 71	STAR	SA	TS14235	
CHEYENNE	AIR TERMINAL WOAS	WY	24088	72560	42	55N	108	28W	1622	01 67 - 12 71	STAR	SA	TS0663.3	
CHEYENNE	MUNICIPAL APT WOAS	WY	24018	72564	41	09N	104	49W	1871	01 60 - 12 64	STAR	SA	TS02112	
CHEYENNE	MUNICIPAL APT WOAS	WY	24018	72564	41	09N	104	49W	1871	01 67 - 12 73	STAR	SA	TS0663.3	
CHEYENNE	MUNICIPAL APT WOAS	WY	24018	72564	41	09N	104	49W	1871	01 67 - 12 71	STAR	SA	TS02112	
LARIMER	HUNT APT WOAS	WY	24018	72564	41	09N	104	49W	1871	01 74 - 12 74	STAR	SA	TS14316	
MORCROFT		WY	24021	72576	42	49N	108	44W	1608	01 70 - 12 74	STAR	SA	TS1847.3	
ROCK SPRINGS	MUNICIPAL APT WOAS	WY	24027	72574	41	36N	108	34W	1305	01 50 - 07 52	STAR	SA	TS14235	
ROCK SPRINGS	MUNICIPAL APT WOAS	WY	24027	72574	41	36N	108	34W	2056	01 60 - 12 54	STAR	SA	TS14235	
ROCK SPRINGS	MUNICIPAL APT WOAS	WY	24027	72574	41	36N	108	34W	2056	01 67 - 12 71	STAR	SA	TS1772	
SHERIDAN	SHERIDAN CAP WOAS	WY	24028	72666	44	46N	108	56W	1202	01 49 - 12 52	STAR	SA	TS22211.3	
													TS14105	

**TECHNICAL REPORT DATA**  
*(Please read Instructions on the reverse before completing)*

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16. ABSTRACT  This report presents procedures and criteria for selecting appropriate locations for particulate matter (PM <sub>10</sub> ) monitoring stations. Background on sources of particulate matter, monitoring objectives, spatial relationships and various meteorological considerations used in site selection are provided.		
17. KEY WORDS AND DOCUMENT ANALYSIS		
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